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ABSTRACT

Described is a seminar designed to promote inter-country exchange of experiences on innovations in science and technology education. Countries involved include Afghanistan, India, Japan, Malaysia, Philippines, and Sri Lanka. Each country's program is described pertaining to school levels, teacher training, science teaching, in-service training, background, curriculum, and instruction. (Author/DS)

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ASIAN PROGRAMME OF EDUCATIONAL INNOVATION FOR DEVELOPMENT APEID

Linking science education to the rural environment ~ some experiences

Report of a Mobile Field Operational Seminar,
Philippines and India, 13 August-2 September 1979

UNESCO REGIONAL OFFICE FOR EDUCATION IN ASIA AND OCEANIA
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Chapter One

INTRODUCTION

In pursuance of Resolution 1/4.4/1 of the General Conference of Unesco at its twentieth session, the Mobile Field Operational Seminar on Designing Science Curriculum and Instructional Materials was organized within the framework of the Asian Programme of Educational Innovation for Development (APEID) from 13 to 2 September 1979.

The Seminar was organized by the Unesco Regional Office for Education in Asia and Oceania and the Asian Centre of Educational Innovation for Development (ACEID) jointly with the Science Education Centre, University of the Philippines (Philippines) and the National Council of Educational Research and Training (India), two institutions which are the Associated Centres of APEID.

The Seminar was attended by 8 participants, one each from Afghanistan, India, Japan, Malaysia, Nepal, Philippines, Sri Lanka and Thailand, and the Science Education Specialist from ACEID. The list of participants is in Annex I.

The main purpose of the Seminar was to promote inter-country exchange of experiences on innovations in science and technology education and enable key science educators from countries participating in APEID to make an on-the-spot study of innovative science and technology education programmes in the two countries. More specifically, the objectives of the Seminar were:

i) to provide an opportunity to a group of science teacher educators and science curriculum developers to make an on-the-spot study of selected science education and teacher training projects relating to the development of alternative structures and methods for preparing science and technology teachers, particularly in terms of the new competencies required for linking science with real-life problems and using the environment, community resources and local expertise for providing science experiences; and

ii) to synthesize the experiences on designing and developing innovative science curriculum and related instructional materials and alternative structures and methods for preparing science and technology teachers and develop guidelines for future action and follow-up activities at national and regional levels.

In order to achieve these objectives, the Seminar made an on-the-spot study of selected curriculum development projects and teacher training projects in the Philippines from 13 to 20 August 1979. The Seminar then moved to India where they studied similar projects on curriculum development and teacher education, especially in the rural settings.

In order to record the impressions and deliberations of the Seminar, the participants requested Mrs. Lourdes Carale, UPSEC, Philippines and Mr. S.R. Rao, NCERT, India, to act as rapporteurs of the Seminar. The other participants of the Seminar assisted the rapporteurs in preparing the materials for the report.

The Seminar, during its concluding phase, converted itself into a Preparatory Group Meeting and met at the Asian Centre of Educational Innovation for Development (ACEID), Bangkok, from 3 to 7 September 1979 to synthesize the experiences of the visits and based on these experiences develop guidelines for the organization of national workshops in the participating countries and a sub-regional workshop to synthesize national experiences, the two activities which are to be taken up as a follow-up of this Seminar.

The method of work for the Seminar was that the key project staff members, in plenary sessions, explained the details of the projects and explained the nature of various instructional materials used under the projects. This was followed by detailed question-answer and discussion sessions to enable the Seminar participants to identify the common problems, issues, growthpoints and innovative features. The discussions were then followed by field visits where the actual implementation stage of various projects was studied in greater detail. During these visits the participants of the Seminar had also detailed discussions with the field staff including teachers, principals, and supervisors. At the concluding session during the Indian phase of the Seminar, the participants had the opportunity of a detailed discussion with officials at policy-making level.

In the concluding session, the Seminar considered the draft reports of the Seminar and the Preparatory Group Meeting and adopted them.

Chapter Two

HIGHLIGHTS FROM REPORTS OF PARTICIPANTS

In this chapter are embodied the highlights from the country reports which the participants had prepared prior to attending the Seminar. The country reports took different forms, in some cases discussing the overall educational structure in their country and focusing on science curriculum development and preparation of science teachers, to the description of a selected project dealing with science curriculum development with focus on linking science learning to environment and real-life situations.

AFGHANISTAN

Science curriculum development and teacher education in Afghanistan

In Afghanistan, all educational institutions are organized, supervised and controlled by the government. The emphasis is mainly on the vocationalization of education.

The Ministry of Education has the responsibility of implementing the policies of the government relating to education, ensuring the co-ordination of the learning activities with the general development plan of the government. The latest educational policy of the government emphasizes the following:

1. Ensuring universal, compulsory and free primary education for all children of school age, and creation of all essential provisions for an effective struggle against illiteracy;
2. Expanding free intermediate, vocational and higher education in order to train academic and professional cadres required for economic progress of the country; and review of curricula of schools and of institutions of higher learning; and
3. Creating a progressive national cultural system, and as a first step, ensuring conditions essential for evolution of art and literature, and providing education and publications in the mother tongue of various tribes and nationalities resident in Afghanistan.

The development of the country in terms of improvement in the quality of life of its citizens is reflected in the objectives of the five-year socio-economic development plan.

Linking science education to rural environment

Since April 1978, various attempts have been made to raise the quality of education. The Ministry of Education, together with other development ministries in different areas of social, economic and political life of the country, has started the renewal and systematic review of the curriculum and instructional materials and the preparation of qualified teachers, including those for science subjects.

Emphasis is being laid on the improvement of the existing status of scientific and technological personnel in the country so that it will be possible to train the required manpower to meet the new challenge of socio-economic development.

The various attempts to introduce technology in the country in the past were rather inconsistent with the needs and requirements of the country, and there were not concrete plans to integrate science and technology into national plans for social and economic development of the country. As a result, the science and technology organization was and still remains in its embryonic stage. However, recently, an International Seminar on Science and Technology Development was organized by the government with the support of Unesco/UN as a first step to promote and formulate national science and technology policies for Afghanistan.

Curriculum and Textbook Project

The educational authorities have been aware of all the problems of education which are common to most developing countries. The main concern has been the relevance of the curriculum taught in the schools throughout the country to the socio-economic needs. An outgrowth of this concern has been the establishment of the Curriculum and Textbook Project under the Department of Compilation and Translation, in the Ministry of Education, so as to effect changes in the primary and secondary education.

The Curriculum and Textbook Project is renewing the curriculum and instructional materials based on the recent policy guidelines in order to provide a modern sequential and articulated programme for elementary, intermediate and secondary schools in Afghanistan.

Work of the Science Section

The Science Section of the Curriculum and Textbook Project in the Department of Compilation and Translation is involved in developing independent and systematic curriculum and instructional materials in the following subject areas: nature study for grades III and IV; biology for grades V-X; physics for grades VI-X; chemistry for grades VII-X; and astronomy for grade X.

The new curriculum and instructional materials are replacing what is now called general science which is being taught in the schools. The materials being produced are students' texts and teachers' guide, except for nature study in which the integrated science concepts and activities are being developed.

The process of developing science subject curriculum materials involves the following steps: (1) studying the old curriculum and instructional materials; (2) developing new science objectives for elementary, intermediate and secondary education; (3) developing new curirculum for different science subjects; (4) developing textbooks and teachers' guides; (5) trial testing in pilot schools; (6) evaluating the materials; (7) collecting feedback; (8) revising and reviewing; (9) rewriting the materials; (10) approval by the professional committee members; (11) final approval of the Ministry; (12) printing; and (13) distribution.

Teacher training institutions

At present, there are 14 primary teacher training institutions under the Ministry of Education. Secondary teacher training is the responsibility of Colleges of Letters and Humanities and Science at the university.

The overall administration and academic system of the primary teacher training institutions is centralized. Each institution is headed by a Director. All primary teacher training institutions offer two-year courses of professional training at grades XIII and XIV for suitable graduates of grade XII (men and women). All the teacher training institutions go by semester system. There are two semesters in each year. Each semester has at least 16 weeks of working days. There is a two-week vacation between the two semesters.

Each institution has five subject departments, each with its own head and several permanent staff members. These subject departments are: Department of Language and Arts; Department of Science and Home Economics; Department of Mathematics and Physics; Department of Social Studies; and Department of Education.

The evaluation of student-teachers is based on mid-term examination, final examination and practical assignments.

Present problems

There are problems concerning teacher training and science education which require urgent solutions. The main problems are as follows:

1. The current high school science education programmes are of the chalk-and-talk type, mostly focusing on reading and memorization;
2. The textbooks are highly theoretical, and students are not taught to link science to some of the daily life problems;
3. Science teachers are poorly trained;
4. There are not enough library facilities in high schools and teacher training institutions for students, even for teachers, especially in the national languages to update and deepen their knowledge of modern science;

5. Laboratory equipment is insufficient, and practical experiences are almost non-existent; and
6. There are increasing demands for science education within limited available resources.

INDIA

Recent trends and developments in teacher education; modules and curricula in teacher education in India

New role of teachers

The winds of change are blowing right from the primary school through the university; new forms of teaching and learning are emerging. It is more difficult to become an effective teacher today than before. At present the emphasis is more on learning than on teaching. All teaching is designed to bring about changes in student behaviour. There is an explosion of knowledge with new science and new concepts. The traditional teacher using outdated methods cannot possibly contain the dynamism and interdisciplinary problem-solving approaches of our post-Einsteinian age. A teacher is not merely a communicator of knowledge; he has to facilitate learning and transmit culture and values.

Role of teacher education

A great deal of research has been done in regard to what leads to success in a teacher. As a result, the teacher education programmes are becoming more performance- or competency-based, and not course-based. As many as 15 criteria have been identified. These are to form the foundation of all teacher education programmes that are now being developed.

Salient feature of teacher education curriculum - a framework prepared for the National Council for Teacher Education

The following dimensions in teacher education programmes have been recommended:

1. Relevance of the curriculum to the personal and social needs of children and schools;
2. Flexibility within the framework of acceptable national goals and values;
3. Flexibility for relevance;
4. Flexibility for continuing education;
5. Flexibility for mobility;
6. Interdisciplinary and integrated approaches in teacher education;
7. Education as a discipline;
8. Task-oriented teacher education;
9. Rich and varied field experiences in practice teaching/ internship inclusive of micro-teaching and other innovative practices;

10. The semester system;
11. Continuous evaluation with the focus changing from assessing to guiding;
12. Experiments, innovations and research for development;
13. Institutional planning;
14. Self-learning;
15. Problem-solving;
16. Objective-based instruction;
17. Working with the community; and
18. Related practical work.

Different patterns and modules of teacher education programmes

Science has a very important place in Indian school education, right from the primary to the higher secondary level. Work experience and vocational bias are integrated with science education. There is a great demand for teachers of science at various levels. The following patterns of teacher education curricula cater to the needs.

Science education programmes in teacher education

A. Secondary level

1. One-year teacher training programme

In most of the colleges of education in the country, graduates in science disciplines undergo a one-year professional programme, which gives them the license to teach at the secondary school level. This is the most popular pattern prevailing in the country, though it has many inherent dificiencies, due mostly to inadequacy of time. The teachers specialize in methods of teaching two science special subject areas.

2. An experiment in the integrated scheme of teacher preparation

A four-year integrated course in science education after 10 years of schooling for the preparation of secondary school teachers was started in the College of Education at Kurukshetra in July 1960 on the recommendation of a committee constituted by the then Punjab Government. The scheme was so devised as to prepare science teachers with thorough and deeper background in the subject areas. The scheme was expected to attract some really bright students to the teacher education programme. Only first-class matriculates were admitted to the first-year college course.

As is well known, every innovation meets with a great deal of resistance and criticism. One criticism was that a handful of quality teachers are produced under this practice. A committee compared the performances of the one-year B.Ed. products and the four-year B.Ed. products, and came to the conclusion that four-year students were much better in their performance in theory and practical skills in teaching.

3. Innovative integrated teacher education programmes in the Regional Colleges of Education under the National Council of Educational Research and Training (NCERT)

One of the major events in teacher education has been the establishment of the National Council of Educational Research and Training (NCERT) at New Delhi and the starting of four Regional Colleges of Education, specifically to integrate professional and general education and to supply trained teachers in the fields of science, commerce, technology, agriculture and English.

The two distinct advantages in this interdisciplinary integrated programme of teacher education are:

a) Both the teacher educator and the trainee know well in advance what kind of competencies are expected to become effective classroom teachers.
b) In the one-year teacher training programme, students who have obtained a degree would generally come to teacher education programme as the last resort. This is eliminated in the four-year programme.

4. Two-year M.Sc.Ed. programme in teacher education at the Regional Colleges of Education under the NCERT

The Kothari Commission emphatically stated that the +2 stage of education in the 10+2+3 pattern was definitely under secondary education. With this concept, educationists saw the necessity for preparing effective classroom teachers to teach at the +2 level after 10 years of schooling. With this end in view, M.Sc.Ed. programmes in physics, chemistry, mathematics and life sciences have been started in the Regional Colleges of Education with rich resources in terms of faculty and laboratory facilities.

5. Two-year teacher education programme

In view of the inadequacy of time in the one-year B.Ed. programme and many other deficiencies noticed in regard to the competencies of teachers, a curriculum for a two-year teacher education programme has been worked out. It is proposed to offer diversified courses in this programme under electives, so that in addition to teachers, the programme can produce evaluation experts, guidance specialists, work experience specialists, etc.

B. Primary level

At the primary level, the programme is of two years' duration for candidates who have completed 10 years of schooling.

C. Elementary level

To prepare teachers for the elementary school level, there are three kinds of programmes:

1. A two-year programme for those who have completed 10 years of schooling.
2. A one-year programme of B.Ed. (elementary) for those who have completed 15 years of schooling and who are graduates.
3. At the +2 level, Education I and Education II are offered as vocational subjects. These students, after a successful period of internship in teaching for six months, are eligible to teach at the elementary school level.

Science is not taught discipline-wise, but as an integrated body of knowledge, with emphasis on environmental approach.

Innovative curricula in primary schools tried out under the guidance of teacher educators at the elementary level

1. Primary education curriculum renewal (UNICEF-assisted) Project II

Fifteen States in the country have taken up this project and the NCERT is responsible for co-ordinating the projects in the participating States. The main responsibility for actual execution/implementation of the projects at the State level lies with the State Governments. The specific objectives of Project II are:

a) Formulation of suitable objectives of primary education;
b) Development of innovative curricula;
c) Development of suitable instructional materials for the child;
d) Development of suitable instructional strategies;
e) Development of suitable emotional climate in the school for the promotion of desirable values and behaviour patterns among the children; and
f) Development of scientific tools for pupil evaluation.

2. Comprehensive access to primary education

Universalization of education is a constitutional obligation. The causes for the slow progress of universalization of elementary education in the country have been the non-availability of educational facilities and the problem of non-enrolment despite the availability of schooling facilities in some areas. The Project CAPE assumes that the goal of universalization of elementary education can be achieved through full-time as well as part-time schooling, providing for a convergence of formal and non-formal education. The major focus of this project will be on learners from the disadvantaged population, girls and learners from backward classes in particular. The criteria for developing the curriculum under this project are relevance, flexibility, local specificity, socially useful productive work, social service, and decentralization of curriculum. The role of teacher training institutions in the process of curriculum development is very vital in this project.

JAPAN

1. The planning mechanism for science and technology education in Japan

The subjects to be offered and the standard of school hours per year for each subject in elementary and lower secondary schools are provided for in an ordinance of the Ministry of Education entitled "Enforcement Regulations for the School Education Law". For upper secondary schools, the same ordinance lays down only the kind of subjects to be offered.

The basic framework of school curricula including the objectives and standard contents of teaching in different subjects is provided by the "Official Curriculum (or Course of Study)", which is compiled by the Ministry of Education for each of the three different school levels on the basis of the recommendation of the "Curriculum Council". The revised curricula were put into effect in April 1971 for elementary schools, in April 1972 for lower secondary schools, and in April 1973 for upper secondary schools.

Science education at the first level

The objective of the primary school science is to acquaint children with nature and make them understand the matters and phenomena in the natural world logically and objectively through the process of observation and experimentation, thus increasing their comprehension of nature and developing their scientific ability and attitude.

The contents of science education are "Living Things and Their Environment", "Matter and Energy" and "The Earth and the Universe". These three areas are co-related with each other, and the teaching materials are carefully selected with due consideration of local needs and of pupils' interests.

Science education at the second level

The objective of the lower secondary school science is to develop the pupils' ability and attitude towards a scientific way of thinking and their interest in learning about the phenomena of nature. At the same time, the lower secondary school science aims at increasing the pupils' understanding of the relationship between nature and human beings.

The lower secondary school science consists of two integrated areas of study. One covers teaching items organized from the standpoint of physical science, and the other covers the items organized in such a way that living things and their environment may be studied from the standpoint of biological science (biology and earth science).

The upper secondary school science aims at increasing the students' interest in the phenomena of nature and develop a scientific way of thinking and their creative ability. In the process of learning, students are led to understand nature and the environment, and the various concepts and processes involved. The emphasis is on the enquiry approach.

Technology education at the first and second levels

In elementary schools, no systematic technological education is offered. In secondary schools, technological subjects are taught as required. The secondary school technology education aims at having pupils and students acquire knowledge and techniques, understand the scientific basis of industrial technology, and also develop their creative ability.

Technology education is an integral part of general education, and the boys of lower secondary schools are required to study the following six subjects: drawing, wood work, metal work, machine engineering, electrical engineering, and horticulture.

The objective of technology education at the upper secondary school level is to have students acquire knowledge and techniques, to develop their creative ability, responsible attitude towards work, and willingness to co-operate with others. The departments in which technology education is offered are: departments of machinery, motor vehicle, ship-building, metal industry, electricity, electronics, information processing, industrial measurement, building, civil engineering, environmental engineering, industrial chemistry and textile engineering.

Science education and technology education in out-of-school programmes

The out-of-school education in science and technology for youth is offered by correspondence courses or miscellaneous schools. A skill measurement system has been established, through which persons who have acquired skills through these courses or at the school may be given a certificate.

Children's culture centres and science museums established and operated by the central government and local public bodies have been providing a place for out-of-school activities for young people to acquire scientific knowledge and undertake scientific experiments.

2. Organization and institutional arrangements for training and research in science and technology education

Prefectural or local educational centres or science and technology education centres have been offering in-service training for teachers, and facilities for research on curriculum development or science equipment production. These centres also organize periodic meetings to discuss the science and technology education

of today and the future, and to exchange information on educational innovations. Other forums for such discussions are the teachers' organizations, such as the associations for elementary school science teachers, lower secondary school science teachers and upper secondary school science teachers. The membership of these associations is not confined only to the teachers of the schools, but also includes the supervisors of science education and university professors. In order to encourage research on science education and the development of new experiments and apparatus, the Ministry of Education has since 1968 been giving these associations the "grants for special projects in science".

3. Supply and development of instructional materials (textbooks, equipment, etc.)

Textbooks for science are prepared by private textbook publishers, but are subject to the authorization of the Ministry of Education for use in schools. The textbooks to be used in schools are selected from among the "authorized textbooks" by the local educational authorities and the school teachers. Textbooks for primary and lower secondary schools are supplied to pupils free of charge. Besides, teachers' guidebooks or instruction books, which give the examples of teaching methods, are prepared by the Ministry of Education.

The standard of equipment has been set by the Science Education Promotion Law. Audio-visual aids are produced by private film producers and reviewed by the Ministry of Education before they are used in schools. Schools are aided financially by the Ministry of Education in the purchase of these materials: overhead projector, TV set, film and slide projector. In audio-visual education, there are approximately 900 audio-visual libraries throughout the country, which supply films for schools as teaching materials on a loan basis.

4. Training of teachers and other educational personnel for science and technology education programmes

(a) Teachers

Primary school teachers, who teach all subjects, are trained in a four-year course at national universities or a two-year course at junior colleges. To teach in the schools, all teachers must have the necessary certification.

Secondary school teachers teach a subject or subjects in which they specialize. They are trained in the four-year course of national universities or the two-year course of junior colleges.

In an effort to improve and maintain the quality of teachers, the Ministry of Education has been organizing a three-day discussion meeting every year since 1971. The meeting is intended for the representatives of research groups to study the topics that have

been selected as being of common interest to all the elementary school teachers in every prefecture. For the lower secondary school teachers, the Ministry has, since 1972, been holding a national meeting of teachers every year for the purpose of introducing to them the revised curricula. Seminars, too, have been organized by the Ministry since 1968 for the modernization of science education, which aims at retraining one-half of all science teachers in a period of five years. Thirty-one universities all over Japan have research laboratories for science education research and teaching.

(b) Science supervisors

For supervisors and advisers of science education in primary and secondary schools, a two-day seminar is held every year in each district. At the central level, the Ministry of Education organizes once a year a workshop for supervisors of secondary school science education to discuss and study topics of practical importance. A national seminar provides another opportunity for supervisors and staff members of science education centres to study innovations in science education and conduct research with experimentation. A recent development was the establishment in 1972 of the Science Education Research Centre in the National Institute for Educational Research (NIER), which aims to help the exchange of information on the research activities undertaken by supervisors, staff members of science education centres and others.

5. Research and evaluation in science and technology education

The National Institute for Educational Research has for many years been doing fundamental research for the improvement of curriculum. At the same time, science education centres established and operated by local educational authorities have become more and more active in offering in-service training courses for teachers. The principal activities that are carried out by many of these centres are: planning and organizing short courses for modernization of science and technology education; study of methods of teaching that could help increase the pupils' interest in science and technology; technical guidance to new inexperienced teachers in basic observation and experimental work; development of new methods of experiments; and development of new teaching materials and equipment. If necessary, the members of all the centres meet once a year to report on the new developments and discuss about the ways of solving the problems of common interest to them all.

6. Major trends in science and technology education

Curriculum development: During the past ten years, the need for innovation in science education has keenly been felt among scientists and science educators. In its efforts to meet the needs, the Ministry of Education launched in 1968 a financial assistance

programme under the name of "grants for research on curriculum development projects in science". The findings of research work aided by the Ministry were published in 1973.

Development of teaching/learning materials: In addition to authorizing textbooks, preparing teachers' guide books and reviewing audio-visual aids, the Ministry of Education prepares materials for seminars for teachers to make them familiar with newly designed curriculum and its teaching methods.

Equipment: With a view to strengthening the experimental and practical work facilities of schools, new equipment and apparatuses were developed, and efforts have been made by the Ministry to revise the standards in regard to the equipment and apparatuses, which were earlier set by the Science Education Promotion Law.

New instructional methodologies: At present, a wide variety of audio-visual aids are being utilized in science and technology education. Examples are tape recorders, radio receivers, slide projectors and cameras, overhead projectors, film projectors, slide projectors and cine-cameras, television sets, video-tape projectors, teaching machines; analysers of learning situation of pupils, and computer-assisted instruction.

NHK (Nihon Hoso Kyokai, or the Japan Broadcasting Corporation) broadcasts science and technology education programmes. The programmes are prepared by the Programme Council of NHK in accordance with the "Official Curriculum (or Course of Study)". As one of the new instructional methodologies, a man-machine system has been introduced into the classroom. It is used very often in science and technology education. The above-mentioned multi-media are used more often in ordinary classrooms, and eventually in science and technology classrooms. How to make full use of them in science and technology classrooms is indicated in a teachers' guide-book prepared by the Ministry of Education.

Utilization of community resources (including community problems as learning resources): Science and technology museums established and operated by the government, central, local (prefectural and municipal), community, business establishments or private organizations, offer educational programmes. In addition to the museums, (338 in number), there exist children's culture centres (28) and youth hostels (4), which are also active in educational activities.

The Science and Technology Agency of the Prime Minister's Office subsidizes these museums in their operation of mobile museums with a view to diffusing scientific knowledge.

In the children's culture centres, which have been established as public welfare activities centres, there are science and technology rooms which are open free of charge to the children who wish to carry out experiments or to build models in science and technology.

In addition, zoological and botanical gardens which are operated by the government, central or local, or local community organizations have their programmes of ecological field surveys, geological surveys, or collection of animals and plants.

Another set of community resources are the broadcasting programmes of NHK and other private broadcasting establishments. The programmes are put on the air by radio and television for the citizens in addition to those for schools for the betterment of the citizens' scientific and technological knowledge. These learning resources are being utilized to a fuller extent as the number of households with radio and TV receiving sets has been increasing.

MALAYSIA

Teacher education with particular reference to science teacher preparation

1. Introduction

Teacher education programmes are conducted by the teacher training colleges of the Ministry of Education, Malaysia, as well as by the Faculty of Education of the universities in the country. All these institutions have arranged their programmes of training to enable teachers, on completion of their courses, to teach science programmes in the schools as effectively as possible. As such, prior to understanding the teacher education programmes, particularly pertaining to science teaching, it may be useful to provide some information on the science programmes at the different school levels.

2. School levels

Education is divided into four levels:

- Primary school level - Standard One to Standard Six
- Lower secondary school level - Form One to Form Three
- Upper secondary school level - Form Four to Form Five
- Post upper secondary school level - Form Six (lower) to Form Six (upper)

3. Science education in the primary schools

Children enter the primary schools at the age of about seven. Education in the primary schools covers a period of six years, and science is taught three periods per week to all classes ranging from the first year to the sixth year. The objective of science education in the primary schools is to develop in children:

a) Understanding and appreciation of things around them;
b) Ability to obtain useful information (e.g. weight, colour) of things around them;
c) Understanding of the importance of natural resources;

d) Scientific skills pertaining to sense of touch, smell, etc.;
e) Ability to analyse and reason; and
f) Interests in science.

4. Science education in the lower secondary schools

Classes in the lower secondary schools range from Form One to Form Three, and all pupils in these three forms follow the "integrated science" programme which was embarked upon in 1969 by the Ministry of Education, as a pilot project, with some 22 schools teaching it. All lower secondary schools in the country are now following this programme, which stresses on the need for pupils to discover things through enquiry and activity. In this respect, more guidance is required of the teacher. This programme aims at enabling the pupils to acquire:

a) In knowledge and understanding

i) Knowledge of some facts and concepts concerning the environment;
ii) Knowledge of the use of appropriate instruments in scientific experiments;
iii) Adequate scientific vocabulary;
iv) Ability to communicate, using this vocabulary;
v) Comprehension of some basic concepts in science so that they can be used in familiar situations;
vi) Ability to select relevant knowledge and apply it in new situations;
vii) Ability to analyse data and draw conclusions;
viii) Ability to think and act creatively.

b) In attitudes

ix) Awareness of the inter-relationship of the different disciplines of science;
x) Awareness of the relationship between science and other aspects of the curriculum;
xi) Awareness of the contribution of science to the economic and social life of the community;
xii) Interest and enjoyment in science;
xiii) Objectivity in observation and in assessing observations.

c) In practical skills

xiv) Some simple science-based skills;
xv) Some experimental techniques involving several skills.

5. Science education in upper and post-secondary schools

Depending on the performance of the pupil in the integrated science programme on completion of his secondary school education, he may follow the science programme in the upper secondary school

level as separate disciplines such as biology, chemistry, and physics or physical science and biology or modern science. Modern science is of a general nature. At the post upper secondary level, separate disciplines such as biology, chemistry and physics are being taught. The various science subjects mentioned above are extensions from the integrated science programme taught in the lower secondary schools.

6. Integrated teacher training programme

All teacher training colleges follow the integrated teacher training programme which was embarked upon by the Ministry of Education in 1973. This programme covers a two-year period for the training of teachers for primary schools as well as lower secondary schools. Among others, one of the aims of the integrated teacher training programme is to provide training for teachers to enable them to teach at different levels. All student teachers in the first year of their training follow a course preparing them to teach science from Standard 4 to Form I. In addition, they are given a brief introductory survey of Standards I to III work and are also given some basic ideas of teaching and learning in the Remove Class. However, in the second year of training, the students who choose science as their optional subject have to join one of the two following groups:

a) Doing science as one of the subjects for early childhood education and relevant pre-school activity and academic enrichment, i.e. pre-school, Standards I-III;
b) Doing science as one main subject for early adolescence education, i.e. Remove Classes, Form II, and Form III and academic enrichment.

Evaluation of the student-teachers in the integrated teachers training programme is in four sections, namely, written examination, course work, teaching practice and extra-curricular activities, and all student teachers are required to pass in each of these sections for fulfilment of their training at the college.

Only the training of teachers for the primary schools as well as for the lower secondary schools are mentioned here. The training of teachers for the upper secondary schools is generally dealt with in the universities in the country.

7. Science teaching

As a science teacher may move from a primary school to a lower secondary school or vice versa due to exigencies of service, the ability on his part to teach science effectively at different levels as described above requires that he should have a greater breadth of understanding both of subject matter, and of the learning characteristics of pupils. As the overall time which can be devoted to the preparation of teachers in the college is limited, it therefore becomes increasingly important to pay special attention to the

selection of topics to be covered in detail and to methods of instruction which are to be used. Apart from this, the student-teacher is encouraged to plan and innovate, on his own, some programmes along the lines similar to those given in the text through selected projects. In this respect, much of the instruction gives emphasis on practical work, fundamental concepts, general principles and teaching methods.

It may be emphasized here that ability to improvise is a great asset on the part of a teacher, bearing in mind that many scientific ideas can often be more effectively illustrated by improvised apparatus. Successful improvisation can give a sense of achievement to the teacher and also provide powerful stimulus to his pupils. This being the case, students are provided with facilities to work on improvisation of materials. Over and above all these, the student-teachers are being encouraged to develop the necessary attitude towards science teaching, such as being able to accept ideas from pupils and other sources. However, it must be realized that this attitude cannot be imparted by instruction alone, but is an outcome of his participation in the various activities pertaining to science teaching and learning.

8. In-service training and seminars

Apart from conducting pre-service programmes, colleges also conduct in-service training and seminars which can generally be divided into two categories. The first category pertains to those conducted for teachers during school vacations. These in-service programmes are generally non-sequential and are conducted on various specific themes such as science, mathematics, guidance, etc., covering both content and approach. The second category requires a teacher to attend a course during school terms for a period ranging from one term to three terms. In-service courses in the second category enable a teacher to teach in higher Forms such science subjects in which his basic training earlier had not provided for.

9. Technical and vocational teachers training

It is to be mentioned here that vocational and technical education forms an important component in Malaysia's education programmes in its efforts to provide the necessary manpower for national development. As such, some of the teacher training colleges together with the Technology University and the Agriculture University play an important role in providing the required teachers for vocational and technical schools in the country.

NEPAL

/The following description tries to throw some light on science and technology education programmes at the secondary and university levels in Nepal in the context of some innovative steps undertaken in the fields of curriculum and instructional materials development. An introduction to a work plan of technical schools

is also included. Both the technology education programmes at the school level and that of Tribhuvan University at the tertiary level in different fields are also briefly discussed7.

Background

The education system of Nepal fully recognizes the importance of science and technology education. It attempts to improve the quality of teaching/learning by bringing science and technology to bear on real-life problems and by using the environment, community and local expertise for widening the people's experience in modern science and technology. With the implementation of the National Education System Plan (NESP) in 1971, Nepal not only stresses, but also made a planned approach to the development of technical manpower needed for the socio-economic development efforts of the country. Towards this end, a policy of promoting science and technology education has been followed throughout the country. In accordance with the guidelines set by NESP, greater emphasis has been given to the vocationalization of education; and as a result, a greater proportion of the education budget has been spent on developing the infrastructure needed for the expansion of technical and vocational education. The curricula, both at the school and university levels, have been remodelled to achieve the objectives of vocationalization of education. A number of innovative research centres and agencies have been established, and seminars, workshops, and research projects have been organized for the development of science and technology education.

Curriculum and instruction

There are at present 117 vocational schools evenly distributed in 70 districts of Nepal (there are altogether 75 districts in Nepal). This is 20 per cent of the total number of secondary schools in the country.

In the curriculum of vocational schools, 40 per cent weightage has been given to vocational subjects, and 20 per cent weightage to science and mathematics subjects, whereas in the general schools more weightage is given to science and mathematics along with humanities to provide a good background for higher studies. Both these groups fulfil the requirements of entry to technical education at the university level. However, in the implementation of the new curriculum, there has been a serious handicap due to lack of qualified teachers (more than 55 per cent of teachers are untrained). Subjects like science and mathematics are being taught either by teachers without any science background, or by under-qualified teachers. The result is that the students have a poor foundation in these subjects. Naturally they develop a negative attitude towards science and mathematics, and eventually most of these students drop out. Thus the curriculum which is, in a way, adequate and of the right standard makes no sense at all in actual practice because it is not implemented properly. The Institute of Education (IOE), Tribhuvan University, is trying hard to prepare the required

teaching manpower by carrying out both in-service and pre-service science teacher training programmes such as short-term programmes, on-the-spot programmes, remote area programmes, women's programmes, distance learning programmes, besides its regular pre-service training programmes.

Instructional materials

The NESP has been implemented to bring about educational reforms in the country. For science subjects specially, activity-oriented teaching is encouraged. This requires more equipment and materials. A Science Equipment Centre (SEC) has therefore been established to look after the problems of designing, developing, and producing science and technology equipment. In addition, the development and use, designing and production of low-cost simple educational materials using locally available resources have also been encouraged. National seminars and workshops are arranged to popularize the concept of improvization. The following activities are generally carried out in these workshops: displays of low-cost/simple materials produced within the country and toys being used in the country; demonstration to illustrate the use of locally available materials; joint design and production of prototypes and exemplars of low-cost/simple materials; identification of basic tools and basic materials; and possible methods for maximizing the use of locally available resources to produce low-cost/simple materials.

As the cost of providing equipment and teaching aids depends on the availability of the raw materials used, various strategies have been worked out in order to strengthen the development of low-cost materials. Some of these are: materials through community; materials through students; proper storage facilities; training and orientation of teachers for using natural environment for science learning experiences, and use of some basic tools and some essential raw materials; utilizing the expertise of local skilled craftsmen such as blacksmiths, goldsmiths, potters, carpenters, dyers.

Technical school

The NESP aims at producing different levels of technical and non-technical manpower, and also at orienting the whole educational process towards the minimum educational wastage. Vocational and technical disciplines have therefore been given first priority with a view to enabling students to have the necessary skills and know-how to carry on a trade of their own independently. A new plan is being developed to meet the requirements of skilled manpower for the rural developmental efforts in the area of agriculture, rural construction work, cottage industries, co-operative organizations and health, as also the skilled work force for urban areas in the field of industrial establishment and development projects such as roads, irrigation, hydro-electric projects, building, carpentry, electric fitting.

The training courses in the technical schools will be mainly of a terminal nature. Successful trainees from the secondary technical school shall be awarded SLC (School Leaving Certificate) technical certificate. There will, however, be a provision for a few talented students to be admitted to higher studies in the concerned technical institutes of Tribhuvan University.

High-level technical education

Tribhuvan University, the only university in Nepal, has four institutes producing medium and lower-level technicians for agriculture, medicine, engineering, and forestry relevant to Nepalese development needs. Among them the Institutes of Agriculture, Medicine and Engineering have also started training graduates (diploma level) from this year on. In 1978 the number of students receiving technical education in various institutes was 24.7 per cent of the total enrolment in the higher education level. In the fifth Five-Year Plan (1975-80), there are plans to further increase the capacity of these institutes.

The Curriculum Development Centre (CDC) of Tribhuvan University, as an innovative and co-ordinating centre of the University, looks after all the aspects related to curriculum development and teaching-learning activities of the University.

PHILIPPINES

Community-related studies in two rural communities

Introduction

Research and development studies are currently being undertaken by the University of the Philippines Science Education Centre (UPSEC) to provide the baseline data for the development of curriculum materials for the 1980s. The textbooks and other formal instructional materials produced so far by the UPSEC can generally be described as discipline-based. While there was emphasis on science processes in addition to content, and a conscious effort to include skills of practical value to the student, the approach primarily considered the science topics into which the practical application could fit in. With the worldwide concern, especially in developing countries, to channel educational efforts towards the improvement of the quality of life of the people, the UPSEC is now focusing its attention to the rural community where about 70% of the total population lives. Through an assessment of the community needs and resources, topics derived from real-life situations will be identified for development into learning units.

The more common types of Philippine rural environments are: (a) rice/corn farms; (b) fishing villages; (c) upland communities; (d) coconut farms/abaca farms. A rice community has been extensively studied in one project of the UPSEC. In operation for quite some time are the projects based in a fishing area and in an upland

community respectively. A project which is relatively new concentrates on a coconut-raising community and an abaca-raising community. The last project mentioned, being done by the elementary science work group, is the subject of this report.

Objectives of the project

The main objectives of the study are to:

a) Provide useful information about the two types of communities, their resources and needs;
b) Determine the children's relative cognitive levels, their vocabulary skills and knowledge of science processes; and
c) Develop curriculum materials in elementary science (grades III to VI) related to the children's environment.

Rationale

Learning in the formal setting is facilitated if a child is taught science concepts and skills related to his environment. Thus, he becomes equipped with the necessary skills to enable him to become an effective, participatory member of the community.

Phases of the study

Phase 1

a) Gathering of preliminary data which includes identification of the site, ocular inspection of the community, informal discussions with local leaders, organization of structure for conducting the interview.

Linkages have been established with the regional offices of the Ministry of Education and Culture (MEC) and coconut/abaca development agencies who will collaborate with the UPSEC in this project. These agencies have helped the UPSEC to identify the sites and to gain an entry point into the two types of communities. The criteria for selection of the site are: (a) major crop raised; (b) accessibility; (c) presence of a complete elementary school; and (d) attitude of the people in the community.

For each community, four school teachers have been identified by the MEC as field interviewers. The school supervisor and rural village captain will act as local co-ordinators. These are authority figures whom rural people trust, and who can therefore get the desired information more effectively than if done by the UPSEC staff who are strangers in the community.

b) Preparation of instruments.

The community study will be accomplished through: (a) interviews and informal discussions with the rural adults; and (b) observation of the community. An interview guide and observation guide have been drafted and are currently being finalized based on

the suggestions of the agencies involved in the project. The interviewees are to be identified through stratified random sampling on the basis of their occupation.

The instruments for the studies on children, namely the cognitive level test, vocabulary level test, test of science processes have been previously designed for other projects of the UPSEC and are being adopted for this study.

Phase 2

a) Study of the community through interviews, surveys, observations;
b) Studies on children: cognitive level, vocabulary level, knowledge of science processes;
c) Analysis of interview results;
d) Listing of topics relevant to science teaching.

Two members of the elementary science work group are to live in the community for at least one week of each month during the interview period of 6-months' duration. They are to interact with the people to learn with them and from them. For example, indigenous technology or the traditional way of doing things is worth looking into, for possible dissemination to other areas.

After the interview, a listing of topics and skills relevant to elementary science teaching will be drawn out. These topics will be given priority by the rural adults, thus giving them an opportunity to decide which are to be learned by the children in their science classes.

Phase 3

a) Preparation of task analysis for learning units to be written;
b) Preparation of testing materials, games/tools to accompany the learning units;
c) Writing learning kits.

Depending on the topics to be written, individuals from specialized agencies such as regional agricultural and vocational schools, will be tapped as writers, consultants, and resource persons.

Conclusion

The project is attempting to use both a multi-level and an interdisciplinary approach to the development of curriculum materials. It involves not only the integrated efforts and know-how of people from the various disciplines, but it also brings in a new and essential source of input to the curriculum development process - the rural folk.

SRI LANKA

Science education in Sri Lanka

Introduction

With the installation of the new Government in Sri Lanka, in July 1977, the science education programmes underwent a change of emphasis in approach from content-based to environment-based, at the junior secondary level.

The science programme

The science programmes are operative at the junior secondary level, i.e., Grades VI to X and at the senior secondary level, i.e., grades XI and XII.

1. Junior secondary level

At the junior secondary level, an integrated science programme is operative nation-wide. The schemes and teaching materials are prepared by the Curriculum Development Centre, and the use of these schemes and materials by the teachers is supervised by staff trained by the Centre. Competent teachers with good academic background and experience are selected and trained as master-teachers. There are two such teachers in each of the 30 educational districts.

a) Master-teachers

The master-teachers work out their own programmes to suit the schools in their respective districts so as to minimize disturbance caused by the absence of teachers in attending in-service training. There is very good response by the teachers for this type of training, as evidenced by the high attendance rates registered at these in-service sessions. The master-teachers are trained every 3 months so as to update their approaches and techniques of presentation.

b) Science equipment

Equipment for the integrated science programme is supplied by the Ministry of Education, through its network of district science equipment stores. Petty cash imprest is given to every school to purchase perishable and other materials through these stores. Replacement and replenishment of equipment and materials take place regularly on the requests of the respective school principals.

Most of the schools have science rooms and currently a phased programme is in operation to provide every school with a science room. The number of schools involved is around 5,000.

2. Senior secondary level

At this level, science is taught as separate disciplines, namely, physics, chemistry, pure mathematics, applied mathematics, botany and zoology. About 400 schools offer science education at this level. A major constraint in expanding the science programme at this level is the lack of competent and qualified teachers. The syllabuses are such that they could be taught only by graduate teachers in science and mathematics. Due to the non-attractive salary scales offered by the government to the teaching profession, most of the science graduates are attracted to other kinds of jobs available readily in the private sector and corporations. Due to this reason, admission to the science stream at the senior secondary level has been restricted by imposing entry requirements. Even with these restrictions, the Ministry is forced to increase annually the number of schools offering science courses. The rate of increase is about 5 per cent now. Due to this reason, the Curriculum Development Centre is now charged with the added responsibility of training some non-graduate science-based teachers in the school system to be used at the senior secondary level.

a) In-service training

In-service training for senior secondary science teachers is conducted by the Curriculum Development Centre, with academic support from the university staff. As the syllabuses have been revised to include new content and approach, it has been necessary to conduct in-service training throughout the year to cover the entire science teacher population at this level. These in-service programmes are conducted both at the Curriculum Development Centre and at the regional and district levels. Teachers are paid travelling expenses and subsistence allowances for attendance at these in-service centres.

b) Laboratory facilities

All senior secondary science schools have laboratory facilities. But those schools that have been approved recently do not have adequate laboratory facilities. The Ministry has now launched a crash programme to provide these facilities with the co-operation of the school development boards. Science equipment, as in the case of the junior secondary level, is provided by the Central Science Store of the Ministry of Education and through its regional science stores. The regional science stores are regularly replenished by the Central Science Stores.

c) Supervisors

Supervision of science programmes is done by the science supervisory staff. Every education district has a science supervisor, who is a science graduate, with professional post-graduate qualification. These science

supervisors are also acting as co-ordinators for in-service training programmes. The supervisory staff is always kept informed of the activities that take place at the Curriculum Development Centre. They are also summoned regularly for briefing sessions. Action is now being taken to increase the science supervisory staff in view of the increasing involvement at this level to improve the effectiveness of supervision.

d) Production of science equipment

The Ministry of Education has its own equipment unit. This unit has metal work, wood work and repair sections. About 60% of the wood-based and metal-based school equipment required for the junior secondary integrated science programme is manufactured by this unit, which is still in a developmental stage. When it works at full capacity, it is hoped to manufacture about 40% of the equipment required for the senior secondary level. All items of defective equipment are repaired at the repair unit. The work force at this production unit is 35. There is a design unit at the Curriculum Development Centre, which supplies designers to the production unit.

THAILAND

Introduction

The development of science curricula for schools in Thailand carried out by the Institute for the Promotion of Teaching Science and Technology (IPST) has been documented in many publications concerning curriculum development. Herein only some aspects concerning the nature and characteristics of the curriculum programmes that were related to real-life situations are described.

IPST science curriculum programmes: the relation to real-life situations

The IPST science curriculum programmes have been developed to suit the needs of Thai school settings. Four major components were the main concerns: the objectives of the curricula, the teaching and learning materials being developed; the teacher training programmes; and the evaluation of the outcomes of the curricula.

1. Objectives

The objectives of the IPST science curricula are more or less similar to those of other countries, i.e., they consist of both the portions concerning science for further studies and the portion concerning science for everyday life. The curricula aim at helping students acquire scientific knowledge which: i) can be applied directly to their daily lives; ii) would induce them to observe their local environment including the people's ways of life; and iii) shows the values of conservation of natural resources and

natural habitats. In the field of skill development, they aim at helping students acquire skills in applying scientific knowledge to problems of personal life as well as to problems of public welfare. In the development of scientific attitudes, they aim at having students develop certain attitudes including love of nature, which includes an appreciation of the value of conservation of nature.

2. Teaching-learning materials

In the development of the IPST science curriculum materials, many efforts for linking the materials with real-life situations of Thailand have been made. Some of the examples are as follows:

a) The utilization of Thai data and information to illustrate scientific concepts: The data and information include graphs, tables, pictures, stories and others. These illustrations are used whenever they suit the text. Many attempts have also been made to refer to related research results carried out by Thai scientists for topics in science. These illustrations not only make students feel close to their own environment in understanding scientific concepts, but also help them realize that scientific discoveries can occur at any place by scientists all over the world.

b) The utilization of specimens and materials available in local areas for laboratory activities: A great deal of laboratory activities provided in the IPST curriculum programmes are developed to use the materials available in the country. In cases where surroundings can be used for scientific investigations, practical work is designed to acquaint students with their environments.

c) The production of local equipment has been one of the main concerns. The IPST has its own workshop in which prototypes of equipment are produced. A great amount of laboratory equipment is adapted, modified or even developed from inexpensive local materials. Though the main concern is to economize costs of school purchases, equally important is the concept that simple equipment helps students view scientific activities more closely to their real-life situations than the more sophisticated and imported equipment.

3. Teacher training programmes

In the in-service teacher training programmes, the main emphasis is to familiarize teachers with newly developed curriculum materials. Teachers are also made aware of local materials contained in the programme and suggestions to use them in the most effective ways. Moreover, teachers are given suggestions for replaceable materials where those mentioned by the IPST curriculum programme are not available in the school areas.

4. Evaluation of the programme outcomes

Thai scientific data and phenomena are used as often as possible in the construction of achievement test items. This has been found useful in informing students of their own daily life and environment, and how to apply their knowledge and understanding to solve the day-to-day problems.

5. Other attempts in using the environment and local materials for practical experiences: research projects

One of the serious problems concerning the implementation of the IPST curricula is the lack of teacher's knowledge about sources in the region of useful materials for teaching. The IPST has established projects to search for local materials suited for providing science experiences in particular regions of the country. The local teachers' colleges as well as the regional universities were invited to participate in these projects. Work plans have been designed to gather both specimens and information concerning appropriate local materials which could be used in implementing the IPST curriculum programme.

Chapter Three

PROJECT VISITS

PHILIPPINES

A. Curriculum Development Projects in the Science Education Centre, University of the Philippines (UPSEC)

The UPSEC is concerned with science and mathematics education at the elementary, secondary and teacher education levels of the educational system. Its many objectives relate to the following major categories of activities: (a) curriculum development; (b) research; (c) teacher training; and (d) extension.

The Centre's concept of curriculum development includes science/math. equipment and teaching aids development. The major activity, however, is focused on the development of textbooks and teacher's manuals for all the science and math. courses currently offered in the schools of the country. The centre also develops resource materials for teachers on selected topics or for courses specially designed for the teachers,

Research studies of UPSEC are mainly supportive of its curriculum development efforts. Evaluation is considered a special category of research; for many years, evaluation of textbooks has been a major activity of the centre. Recently however, more attention has been given to other types of research studies, e.g. cognitive growth, development of a test of science processes, community-based research projects, self-directed learning, vocabulary study. Many of these studies will provide a research basis for curriculum development.

The different projects observed at the UPSEC related to curriculum development were: (a) community-based projects; (b) vocabulary studies; (c) teacher materials development; and (d) evaluation.

Community-based projects

Several projects are being undertaken by the UPSEC in different types of communities (rice/corn, fishing, upland, coconut/abaca). These projects are in various stages of development. In the first three types of communities mentioned above, a broader concept of education is implied, which is not limited to the formal system alone. In the coconut/abaca growing area, however, the primary target group are elementary school children in the schools.

In general, projects have the following objectives: (a) to extend the reach of science education to the school, home and community, thereby providing closer links between the learning in school and the learning in the home and community; (b) to use learning situations for encouraging the individual's and the family's productivity; (c) to raise the level of scientific consciousness in the individual, family and community; (d) to utilize materials and the environment for teaching science principles and processes.

Each project is initiated by preliminary studies such as identification of project site, ocular inspection, organization of the local structure to assist in the project, briefing of school and community leaders on the nature, objectives and expected output of the study.

The second phase covers assessment of community needs and resources through a combination of any of the following techniques: intensive interviews, ocular inspection, data from the local government office, informal interview of the local people. Analysis of data gathered is used as basis for planning several activities such as matching needs with available resources, matching research and development efforts with needs, formulating plans and sub-projects, securing the necessary inter-agency co-operation.

Community activities are then planned which involve various members of the community, often taking the form of workshops and seminars for adults of the community. These are conducted by several consultants, many of them from local government agencies, e.g. regional offices of the Ministry of Health, Ministry of Education and Culture, Bureau of Fisheries and Aquatic Resources, state colleges. Topics are selected by the community folk and it is to be mentioned that activities directly related to their means of livelihood are of major interest to the people, for example, in the fishing community, some activities undertaken were construction of a fishpen and improved methods of fish preservation. In the agricultural project, the farmers were involved in experimental farming which gave them experiences in crop protection, fertilizer application, varietal performance, and spacing and distance of rice planting. In the upland community, attention was drawn to alternative economic activities that could be undertaken in the community.

Science education activities took the form of meetings with teachers to discuss current curriculum and how to make it more relevant to family and community activities; the preparation of reading materials of various types, modules, poems, songs, intended for school children, adults, and out-of-school youth. A number of modules can be used for both formal and non-formal systems of education. Through modules, adult activities are often related to science learning in the classroom.

The same basic methodology is being used in the coconut/abaca-growing community, although here, the expected output are learning modules for the formal setting. This time, community activities and development of non-formal materials are not to be directly undertaken by the UPSEC; instead, linkages are being made with other agencies who can carry out those functions. In this way, it is hoped that a complementarity between formal and non-formal learning will be effected.

Vocabulary studies

Language is an important element in the learning of science and mathematics. Non-technical terms which are not normally taught or explained in class, are used by teachers and in textbooks. A knowledge of these terms is therefore necessary for comprehension of science topics. The vocabulary studies have attempted to answer two questions: (a) which non-technical terms are needed by students to learn science and mathematics? (b) which of these non-technical words are difficult for students at each level from grades IV to X?

The basic methodology is to: (a) prepare a list of non-technical terms; and (b) administer tests to students from different parts of the country to determine their comprehension of the terms.

The study for grades VII to X has been completed while the project at the elementary level (grades IV to VI) is still going on. In both studies, the list of terms was prepared in a workshop participated in by teachers from different parts of the country, school supervisors, curriculum specialists from the Ministry of Education and Culture and selected UPSEC staff. After administration of the tests and analysis of test results, reports are prepared. A condensed alphabetical word list and the difficulty level list are then made available to classroom teachers, curriculum developers, researchers, and other interested groups who may find these lists useful.

Teacher - materials development

The UPSEC develops different kinds of teacher resource materials to suit different purposes: (i) teacher's guides to help teachers make effective use of student materials, ex: Teacher's Manual, Exploring the Environment; (ii) enrichment content materials to upgrade the teacher's knowledge and understanding of a science discipline and his competence to teach it; ex: Surface Water, Philippine Environmental Series; (iii) materials on the educational aspects of science teaching, ex: Project WISP (Words in science: Philippines).

Teacher's guides are developed simultaneously with their corresponding student materials. It is thought that teaching is more effective when teachers are made aware of the main thrusts and objectives of a student material, and when they become conversant

with areas of possible conflict or confusion and how to overcome them. The enrichment content materials and the resource materials, the educational aspects of science teaching are developed when there is a felt need as indicated by observations of teacher performance and by informal talks and interviews with teachers. The enrichment content materials are intended to strengthen the teacher's command of subject matter and updates him on the latest developments in specific topics of interest. They are also intended to sharpen his skill in using instructional strategies and classroom techniques found suitable for use with certain science topics. The education-oriented materials, on the other hand, develop and reinforce the teacher's concern for the student as an individual.

Teacher resource material: Philippine Environmental Studies

Essentially, the teacher resource materials on Philippine Environmental Studies are intended to enable the Filipino teacher to relate to his total environment with understanding of the consequences of his interactions with it so that he may teach environmental conservation and management with conviction and competence. In consonance with this overall objective, the environmental resource materials have availed of the most recent findings on the Philippine bio-physical and socio-cultural conditions, built in teachable activities, and structured and organized data and activities with a view to concept and value development.

In order that such materials may cater to the felt needs of the teachers, they are reviewed in teacher workshops and revised on the basis of the feedback. For example, a national teacher training workshop in Environmental Education was held at the UPSEC in March 1979. The workshop focused on the theme 'Water Resources' and the teacher materials on Water Resources were tried out in this workshop. The teachers recognized the importance of basic concepts and principles but they were most enthusiastic about the thrust on Philippines'conditions. For this reason, the final drafts were revised to strengthen this aspect of the teacher materials.

Biology competency courses

The main basis for the preparation of biology competency courses was the inventory of teaching competence or skills expected of secondary science and mathematics teachers. This list was developed, revised and finalized on the basis of the reactions of teacher-participants in summer institutes in different parts of the country. Techniques/activities so far developed into teaching modules have been tried out by researchers and research assistants of the Biology Work Group before being used by teacher-trainees in short-term competency courses. The competency based courses offered by the Centre are: Biology Techniques for Science Teachers (36 hrs.); Techniques in Outdoor Biology (36 hrs.); Microbiological Culture Techniques and some applications (18 hrs.); Techniques in Ecological Study - Grassland Ecosystem, Freshwater Ecosystem (100 hrs.); Collection, Identification and Preservation of Plant

Materials (18 hrs.); Microbiology Exercises for the Secondary Level (36 hrs.). The following is an example of a course and the type of competencies that are covered under it:

Title of Course	No. of hours	Description of Course
Microbiological culture techniques and some applications	18	The course provides high school teachers with practical experience in introducing simple environmental activities into their biology and chemistry classes. It includes the following topics: 1. use of microscope including counting of cells; 2. microbiological standard methods; 3. measuring techniques; 4. examination of culture growth; 5. identification of bacterial cultures; and 6. coliform count of sidewalk refreshments. The course is offered jointly with the Chemistry Work Group.

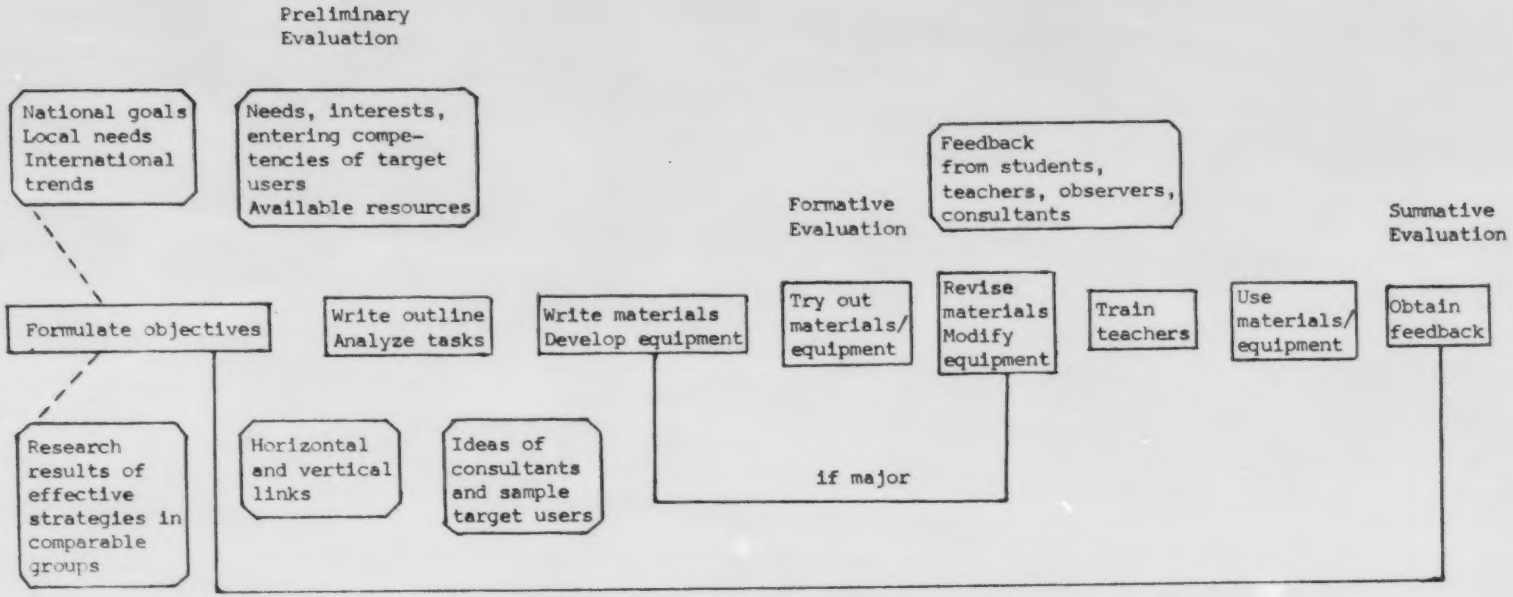
Evaluation

Evaluation of curriculum materials is a major activity of the Centre. An example is the evaluation of the experimental edition of the physics textbook developed by the UPSEC for the National Textbook Project of the Ministry of Education and Culture. The draft of the textbook was tried out on a national scale during the school year 1976-1977, prior to finalization. The tryout involved the following number of schools, teachers, classes and students:

	Experimental	Control
Total number of schools	52	40
Total number of teachers	55	40
Total number of classes	70	44
Total number of students	3,404	2,116

The schematic diagram on the next page shows the various steps undertaken in the development of the text materials and their evaluation:

Evaluation of Instructional Materials and Curriculum:



In the evaluation of the physics textbooks for the try-out, schools were selected from various categories; public schools located in cities, provincial high schools, national high schools, and Barangay schools. In addition, private schools in cities, in the capital or in the towns as also provincial schools were also included. The number of schools and sections were determined by taking the percentage enrolment in each category. The schools were taken in places such that the per cent of urbanization for all the try-out schools was between 30-40 per cent. Other important factor in the selection of the schools was the proximity of schools to the regional offices. It was ensured that at least one development high school or a high school connected with the Regional Science Teaching Centre for every region was included in the try-out.

The various sources of feedback and instruments used during the evaluation were: mental ability test; pre-test and post-test; readiness self-test, mastery self-test, boxed questionnaire, student's questionnaire, teacher feedback, and observer feedback per lesson; chapter tests; monthly teacherlog sheet; principal's questionnaire; teacher overall evaluation form; observer overall evaluation form; teacher-commented pages; and observer/consultant commented pages.

B. Pre-service Teachers Training, Philippine Normal College (PNC)

The Philippine Normal College (PNC) is one of the oldest educational institutions in the Philippines. It is provided with the Charter to award degrees for the various courses conducted. Attached to it is a laboratory school for elementary education as well as for secondary education. This laboratory school is coordinated with the Science Education Centre of the University of the Philippines whereby curriculum materials developed by the Centre are being used in its various classes.

Currently the PNC conducts the following degree programmes:

i) Bachelor of Science in Mathematics Teaching (BSMT)
ii) Bachelor of Science in Physics Teaching (BSPT)
iii) Bachelor of Science in Education (BSE)
iv) Bachelor of Science in Elementary Education (BSEE)
v) Bachelor of Science in Elementary and Secondary Education (BSESE)
vi) Bachelor of Arts or Bachelor of Science (BA or BS)

All the above courses which pertain to education require the students concerned to undergo an internship in teaching in a school for a period of one semester. This arrangement provides them with some experiences in linking theories with practices while pursuing their respective courses of studies.

The Bachelors Degree in Elementary and Secondary Education (BSESE) is a new innovative programme undertaken by PNC since 1977. It is an effort on the part of PNC to train teachers who could

teach mathematics or science in both the elementary school and the secondary school because teachers with such qualifications would help to provide a solution towards meeting the shortage of such teachers, particularly in the rural schools. The following course outline indicates the various courses that are offered under this programme:

First Year

Course	Units
Psychology 1: General Psychology	3
English 1: Basic Communication Skills A (Spoken English)	3
Pilipino 1: Communication Skills A	3
Spanish 1: Basic Spanish	3
Science 1: Physical Science	4
Mathematics 1: Fundamentals of Modern Mathematics	3
Physical Education 1: Self-Testing Activities and Group Games	1
Social Orientation 1	
	20
Education 1: Introduction to Foundations of Education	3
English 2: Basic Communication Skills B (Reading and Writing)	3
Pilipino 2: Communication Skills B and Short Story	3
Spanish 2: Conversational Spanish and Reading Competence	3
Health 1: Personal & Communication Health	3
Social Science 1: Geography (Economics, Social and Political)	3
Physical Education 2: Fundamentals of Rhythmic Activities	1
Social Orientation 2	
	19

Second Year

Education 2: Human Growth and Development	3
English 3: Introduction to Literature	3
Work Education 1: Fundamentals of Agriculture	3
Science 2: Biological Science	4
Nutrition Education 1	3
Physical Education 3: Sports Fundamentals of Volleyball, Softball, Basketball and Track and Field	1
Social Orientation 3	
Major (1)	3
	20

Course	Units
Education 3:Educational Psychology	3
English 23:Readings in Philippine Literature (for English Majors)	3
English 37:English for Special Purposes (for Non-English Majors)	
Humanities 1:Understanding the Arts	3
Mathematics College Algebra	3
Work Education 2:Fundamentals of Handicrafts	3
Health 2:School Health Education	3
Physical Education 4:Methods and Materials for Teaching Physical Education and Recreational Activities	1
Social Orientation 4	
Major (2)	3
	22

Third Year

Education 5:Introduction to Measurement, Evaluation and Research	3
Pilipino 3:Content of Pilipino	3
Spanish 3:Intermediate Spanish	3
Social Science 3:Philippine Government	3
Major (3)	3
Major (4)	3
	18

Practicum 1:(Quarterly) Student Teaching	6
Education 7:Principle of Curriculum Development and Developing Teaching and Learning Materials	3
Social Science 16:Sociology and Contemporary Society	3
Social Science 17:Taxation and Land Reform	3
Major (5)	3
	18

Practicum 2:(Quarterly) Internship	6
Social Science 13:Philosophy	3
Elective in Education	3
Major (6)	3
Major (7)	3
	18

Elective in Education

1. Educational Management
2. Educational Communication and Technology
3. The Teaching of Reading
4. Leadership and Public Relations

Course	Units
Pilipino 4: Literature in Pilipino and Other Leading Philippine Languages	3
Spanish 4: Works of Philippine Heroes	3
Social Science 6: Rizal-Noli and Pilipino	3
Major (8)	3
Major (9)	3
Major (10)	3
	18

Note: Wherever possible, the critical areas of health, nutrition, employable skills and rural transformation will be integrated in the above courses.

The BSPT and BSMT programmes are joint efforts between the Philippine Normal College and the National Science Development Board (NSDB) of the Philippines, aimed mainly at producing more competent physics and mathematics teachers and reducing expenditure on in-service training and upgrading of poorly-prepared science and mathematics teachers in the field. Students for these courses are selected and financed by the NSDB. As these students come from different parts of the country, they are assigned to the respective regional science teaching centres when they undergo their apprenticeship in the different regions.

Technological University of the Philippines (TUP)

The Technological University of the Philippines has gone a long way to what it is today. Started in 1901 as a trade school, it has now developed to the level whereby it has been chartered to offer degree programmes in technology as well as technology education.

Currently, the TUP conducts courses ranging from the certificate level through the Diploma to the Degree level. Courses at the certificate level provide for the training of tradesmen. Such courses are offered for a duration of 2 years. Besides, three year technician programmes ending with a diploma in machining, building, refrigeration and air-conditioning respectively are also being offered. Over and above these courses, the TUP is also currently engaged in Bachelor Degree programmes in Industrial Education comprising no less than seven different areas ranging from ceramics, electricity, graphic art to cottage industries. Graduates of these courses constitute the manpower for Industrial Arts teaching in the elementary schools. The University also provides courses further than the Bachelor Degree in Industrial Education with the aim of providing the necessary manpower for the Arts and Trade Schools in the Philippines.

Beside conducting the full-time day courses mentioned above, the TUP also conducts classes in the evenings for working students who are thus provided with the opportunities of acquiring the

necessary experiences and qualifications to improve themselves. Another useful effort on the part of the TUP is in the provision of short training programmes in bakery and garment making for selected workers of industries and manufactures. Such courses are planned for the requirements of these bodies and as such receive good support from them.

C. In-service Programme

1. Regional Staff Development Centre: University of Santo-Thomas

The Regional Staff Development Centre (RSDC) at the University of Santo-Thomas is one of the 14 RSDCs throughout the country. These RSDCs were established for the effective implementation of newly developed school curricula. In-service programmes held at the RSDC aim to develop necessary skills and competencies of both teachers and teacher trainers who will be staff members of the Decentralized Learning Resource Centres (DLRCs).

The RSDCs' personnel receive training from Curriculum Development Centres in the particular area of interest. When they complete their course work which require at least 3 semesters and 1 summer session for the training, they receive the M.A.T. degree and are ready to be teacher trainers.

The RSDCs personnel hold the summer institutes to upgrade the teaching and evaluation competencies of the teachers and staff members of the DLRCs, and to improve their skills needed in the development and production of instructional materials. Each summer institute is held for a period of six weeks. Qualified participants, on agreements of their respective institutions, are selected by a Screening Committee, and are given full scholarship.

University instructors as well as other specialists in the particular areas are invited in the training programmes. First-hand experiences and audio-visual aids such as video-tapes are designed and used for the effective training. After the completion of the programme, each participant is given a certificate, and those who satisfactorily pass the examinations and fulfill all the requirements of the courses are credited with university units depending on the grade obtained.

Necessary skills in planning and conducting the in-service teacher training programme are also provided in the training for staff development of the DLRCs. Then each RSDC establishes its DLRCs that will respond to hold teacher-training workshops to upgrade the knowledge and skills of the teachers of schools in its particular area.

2. Baguio Vacation Normal School

Baguio Vacation Normal School is a division of the National Research and Development Centre for Teacher Education (NRDCTE) in which many divisions are included. It offers training programmes in a different pattern. The training programmes are held during the vacation periods at a particular teacher camp where participants have to stay together so the human relation skills for effective inter-personal relations are also developed.

The programmes offered by Baguio Vacation Normal School, which are meant for teachers and Ministry of Education and Culture (MEC) field personnel who directly supervise the teachers, include both graduate and undergraduate courses in many subject areas. Participants in the training programmes come from all the MEC regions. The programmes are carried out in close co-operation with educational researchers and personnel from the Ministry of Education and Culture.

3. UPSEC - Teacher training

Teacher training as a function of the Centre was originally focused on training "experimental" teachers (those who would teach experimental editions of the textbooks during the one or two-year tryout period). Soon, however, the UPSEC staff got involved in more formal programmes of teacher training with the establishment of the Regional Science Teaching Centres (RSTCs). Originally there were five of these; now there are fourteen spread out all over the country. Since 1969, the staff of these RSTCs have been trained at the University of the Philippines on an 18 month Master of Arts in Teaching (MAT) programme offered on staggered basis for the different science subject majors and for mathematics teachers of elementary and secondary levels. These MAT programmes have themselves undergone changes over the years, so that now there are MAT programmes but there are also M.S. in teaching programmes. These degrees are granted by either the College of Education (for MATs) or the College of Liberal Arts (for M.S.). UPSEC itself is not a degree granting institution. Its senior staff teach in either or both colleges. Mostly, they handle science/mathematics education courses. The UPSEC also has its own courses; these are non-credit, short term courses, skill or competency oriented, and mainly intended for in-service training of teachers.

INDIA

National Council of Educational Research and Training (NCERT)

The Seminar visited the National Council of Educational Research and Training (NCERT) first, as it is a national level organization, established by the Government of India as an autonomous academic wing of the Ministry of Education, to promote quality in education. The participants were introduced by the faculty

of the Department of Education in Science and Mathematics Education to the various on-going innovative science projects being implemented by the Council and had the benefit of detailed discussions with the faculty of the Department.

General objectives of NCERT

1. To promote quality in education at school levels (primary to higher secondary) and at primary and secondary teacher education levels;
2. To promote educational research in various inter-disciplinary areas of education;
3. To organize in-service and pre-service programmes for the professional growth of teachers and teacher educators;
4. To encourage innovative practices; and
5. To disseminate new knowledge.

A. Curriculum

1. Environmental studies for primary classes

In mid-1960s, a science series was developed with text materials and teachers' handbooks. This was later replaced in late 1960s by another science series entitled 'Science is Doing' with accompanying teacher's guides, science kits and teacher training films for wider use in States. Though in the implementing stage there have been problems such as supply of science kits, training of teachers and other administrative problems, yet the materials have been widely accepted by various States either in the original form or with modifications. Major innovations have since been directed for developing local inexpensive substitutes for expensive kit items or complete local replacement of the kit items.

In 1976, a detailed approach and strategy to "Environmental Studies" has been developed and science experiences form an integral part of this area of study. New environmental materials have been developed which are not directly linked with the kits. Teachers' guides for classes I and II and texts for classes III to V have been prepared. The teachers can teach science principles and ideas using environment familiar to everybody and lesser input is needed in terms of materials. The curriculum is essentially child-centred.

2. Integrated science course for middle schools - linking of science with real life

A new integrated course in science was developed for the age-group 11-14. The fact that middle school stage is the terminal level of education for most of the children; the problems of teacher training; and the psychological point of view of this age-group were taken into consideration while framing the curriculum. The integrating factors; various ranges of flexibilities; the scope of integration; intensity of integration; laboratory requirements; and expected learning outcomes, have been spelt out.

Linking science education to rural environment

What is the integrating factor?

An examination of integrated science curriculum of different countries shows that a wide variety of factors have been used for integration, e.g. 'Environment'; 'The concept of macro molecule'; 'Historical approaches to science'; 'Silkworm as the integrating factor'.

Of all the factors (Environment, Concept, Topic, Process), it was felt that for India, 'Environment' would be the most important integrating factor. It would provide science experiences about the things and occurrences in the immediate environment of the child. Such experiences would help the child to live effectively in his environment and to improve upon it. Such an environment-based programme also will help to bring school and community to come closer.

What is the flexibility?

Various ranges of flexibility are seen in the materials of different countries. Some materials have followed a structured curriculum with a set of textbooks and extensive teachers' guide, while some structured materials showing alternate path are also available. In certain other materials, the structured arrangement is diluted, where teachers have the liberty to use them according to the need. The other extreme is the unstructured curriculum materials in the form of resource book from which the teachers may select items for developing a course.

Considering the prevailing climate in the country's educational field, the introduction of a structured curriculum was felt as the most viable approach. Textbooks were felt necessary to be developed on the basis of a structured syllabus. While writing the textbooks, the only permitted flexibility was the freedom for teachers to select activity from several alternate paths. It was decided that while writing the book, emphasis should be shifted from the fulfilment of cognitive abilities to the abilities of psychomotor and affective domain. For this purpose, instead of stressing on the content, efforts should be made to create interest to promote awareness and to attain certain positive values and abilities.

What is the scope of integration?

Four levels of scope are noted in the different integrated science curricula: (i) two sciences are integrated; (ii) three science disciplines are integrated; (iii) science disciplines are integrated with non-science subjects; and (iv) science with significant social component.

Various prevailing factors were judged before determining the scope of the present integrated science curriculum. It was agreed that integration of three disciplines - Physics, Chemistry and Biology will be attempted. Efforts will be made to cover other subjects like Astronomy, Agriculture, Geology, Nutrition and Health.

It was also decided that instead of attempting artificial integration of different disciplines, efforts would be made to integrate concepts of science with the environment. Thus, social component would be the most significant feature of the curriculum.

What is the intensity of integration?

It was decided to keep the integration at primary level. Whereas there will be concepts from different disciplines, the students will learn them through examples in the environment. It is anticipated that such environment-based understanding will form a structure in itself within the mind of the children. This will help them to live effectively in the environment and also to continue the pursuit of science at the higher level.

What is the laboratory requirement?

This has been a significant component of science education and while planning a curriculum, it is necessary to give careful thought to it. For a long time, it has been accepted that science teaching demands a specialized room where activities or experiments are done through contrived situation. This laboratory dependent science demands more input and therefore poses the most important hurdle in introducing science curriculum at the school. As the resources of the country are limited, it is necessary to develop a science course which will be pedagogically sound but at the same time not costly.

For this purpose, the following strategies were planned:

a) Activities which will be included must be from life situations and as far as possible contrived situations will be avoided;
b) Student activities will be of two types: (i) which will be done in groups during the school hours; and (ii) which will be performed outside the school during play or during other daily life activities;
c) Activities must help to practice the process of science and to understand the scientific principles; and
d) Efforts should be made to use local resources and basic items for doing the activities should be kept to the minimum.

What are the expected learning outcome?

Learning outcome is the sum total of what the child will learn. It fulfils the objectives of cognitive, psychomotor and affective domains. It has been the experience from the past that emphasis on cognitive domain makes the curriculum heavy in content and both teachers and students devote their major time in dealing with the facts, data and other details. Before developing the present programme, the question was considered whether we really want our children to remember all the facts for the rest of their life.

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There is no doubt that even if we wish to do so, it is not possible. Therefore, it was decided that the curriculum should be developed in such a way that the child will:

a) be interested in science;
b) realize the relationship of science with the things and occurrences in the environment;
c) develop the habit of not accepting things as inevitable or destiny;
d) develop the habit of collecting data and analysing them before making an inference in all daily life situations;
e) become curious; and
f) gain confidence to ask questions on things and occurrences which he or she does not understand.

Implementation of the programme

The integrated science curriculum was introduced in a phased manner. The textbook for class VI was published in 1977, for class VII in 1978 and for class VIII in 1979. The team for developing the materials had no voice in the implementation. No teacher training was carried out. A few States, e.g. Delhi, introduced it as a pilot project and are evaluating the programme in the light of the try-out.

The original idea of developing a teachers' guide for each book was abandoned. The main reason for such decision is to minimize the curtailment of teachers' freedom. A teachers' guide for all the three classes is now in the making, which is based on the experience of the teachers in dealing with the programme. It has been felt that this curriculum reflects a new trend of science education. Therefore, orientation of teachers to this new trend is a must. This curriculum is environment-based and environment varies from place to place, therefore, it is necessary to adopt it according to the local situations. A working group of teachers in every State can alone make this course realistic and thus implementable.

Evaluation

The past experience of giving exercises at the end of each chapter led the working group to abandon the practice. As most children do not have anyone to help them in their home, no home task was included, although there are enough materials to take home. In spite of these efforts, as examination has remained an important part of educational system, efforts were made to develop test items. All these tests are more to evaluate the fulfilment of learning outcomes rather than the memorization of facts.

3. Secondary science project: an attempt to introduce activity-oriented science courses

The general aims of the existing science curricula in use in the States and development of specific skills and attitude are the foundation of this project. The theoretical content of the science curricula have changed and developed through the years, and although it is well established that experimental investigation is one of the most effective teaching-learning situations in science, introduction of teacher/student activities has proceeded more slowly, due to various constraints. Many of these constraints, it was felt, could be significantly reduced if one took into account the new knowledge and experience that has been acquired in the development of practical activities, in the improvisation of apparatus, and in the use of the environment. Experimental investigation can and must play the leading role in the scientific education of the secondary school pupils.

To formulate the approach to integrate activities at the secondary level the 'Experimental Science Group' in the NCERT began by seeking answers to three key questions:

a) What are the general aims of the science curricula?
b) What are the specific attitudes and skills that are desirable, to be developed?
c) Bearing in mind the existing school situation, and the fact that this will not change within the next decade, what particular teaching learning situations would be most effective in attaining the objectives?

These questions cannot ultimately be considered in isolation from the syllabus content, which will itself closely reflect the general aims of the science curricula. Consideration of the problem is further complicated by the inter-dependence of the following several factors:

a) Improvement of teaching and learning science depends much on the introduction of experimental activities;
b) Experimental activities cannot be introduced within the framework of the school timetable without reducing the number of lectures;
c) No innovative teaching can be introduced which will ultimately lead to a reduction of lectures unless the school administration, teachers, pupils and parents are convinced that such changes will ensure better performance of the pupils in the external examination;
d) Optimization of the effect of any activity depends on how it fits and where it is fitted in the overall lesson plan of the topic;
e) During the development of the lesson plan, the pitfalls in the textual materials are brought out and the necessity arises to supplement the background materials in order to recall the 'known' and correlate it with the 'unknown';

f) Development of supplementary materials and associated ideas requires a teacher to learn and develop the art of asking questions;
g) For pupil motivation, the presentation of the materials and experimental activities should be interesting and have an element of surprise to satisfy their curiosity;
h) Worksheets, in which a topic is developed according to a graded structure through recollection of familiar situations and known principles, may induce a child to use the materials and ultimately enable him to understand the topic and apply it in different situations;
i) One should be able to assess the reaction of the children to the new method of teaching by conducting opinion surveys; and
j) One should be able to test the children for the desired change in attitude.

The main feature of the approach on experimental activities is integration of these activities with the other methods of teaching, e.g. lecture, demonstration of experiments with or without pupil participation, discussion and quiz sessions, showing of charts, slides and film strips, depicting experimental situations which cannot be improvised in the classroom, homework, filling of worksheets. Here, the emphasis is on the special advantage of using experimental activities in communicating concepts, principles and laws to the pupils.

A pilot project was undertaken in 1976 before recommending this approach for large-scale adoption. Since the aim of the project is to develop materials in all the three disciplines of physics, chemistry and biology, the project has been entitled 'Secondary Science Project'.

All materials for the project were developed through continuous consultations between the design team and the team of teachers. The style of materials developed varied according to the subject. At the end of the academic year, the materials developed were reviewed at a workshop comprising of a large number of practising teachers from the various types of schools.

During the trial, the following practical constraints emerged:

a) Introduction of activities requires giving of additional periods to the topic, and since the teachers feel that the number of periods allotted are in themselves inadequate to cover the full course for the examination purpose, they are hesitant to introduce the activities.
b) Teachers require advance preparation time for demonstrations and practicals which is often not available because of the work-load assigned to them.
c) Facilities are not easily available for conducting laboratory experiments in the secondary classes.

d) There is no provision in the school timetable for practicals in class IX and the experiments prescribed in the course are normally done at the end of class X, thus, completely delinking them from the lectures.
e) The prescribed practical curriculum has to be completed for the sake of the examinations whether it is relevant to the teaching/learning situation or not.
f) The number of pupils in a section of a secondary class is normally about forty and may be as much as sixty. As such, laboratory periods for students become unmanageable and impractical unless the class can be divided into sections.
g) Worksheets involve an additional load on the teacher in so far as corrections are concerned, as it is over and above the prescribed homework and routine tests.

Inspite of these constraints, the teachers of trial schools were enthusiastic about the materials developed, and utilized them to the best of their abilities. This was due to three major factors: (a) they felt that they were directly involved in the development of the curriculum; (b) the students responded favourably and were enthusiastic about using worksheets; and (c) it saved them time and thought about what homework to give.

According to the limited available feedback, most of the activities should be such that the students can do them without the help of teachers and with materials available in the environment, or else can perform them sitting at their desks rather than moving to a laboratory. Experiments which are prescribed in the syllabus should be included in the worksheets but modified to the extent that it is relevant to the topic, and the school timetable should be so adjusted with the help of authorities that the practical and theory run concurrently to ensure an effective teaching/learning situation. Experiments which require glasswares and laboratory equipments should mostly be used as demonstration experiments with student participation followed by a question-answer session, so that the concept is amply clarified to clear difficult points. Answers to the questions contained in the worksheets should be necessarily short to avoid wastage of time on the part of the teacher and pupils alike.

Organization of science exhibitions and science clubs

In order to bring about qualitative improvement in science education at the secondary stage, the Department has been organizing a National Science Exhibition and several state level science exhibitions every year since 1971. These exhibitions give expression to the out-of-class science interests of children. The network of science exhibitions now covers each state and union territory.

4. Supplementary readers in science for schools

In order to support the various curricula, a series of supplementary reading materials have been developed. To begin with, about 50 titles were listed up and experts working in the respective fields from various academic agencies were requested for writing the manuscripts. The draft manuscripts were then sent for critical review, refined and published. All the titles brought out so far have been a success. Most of the titles were sold out in about a year after these were available for sale. Revised new editions for some titles are under preparation.

A second phase is now under planning for preparing Supplementary Readers for the schools, on the basis of the experiences gained so far. A high priority is expected to be given to the programme.

B. Teacher Training Programme

Regional College of Education, Bhopal

The college, which is one of the four Regional Colleges under the NCERT, is currently offering a one-year B.Ed. programme in science education, to prepare teachers for secondary schools. Earlier, the college was offering a four-year integrated science education programme to prepare science teachers for secondary schools.

The B.Ed. Science course is for fresh as well as for in-service graduates and post-graduates of science. The duration of the programme is one year. The curriculum helps the student teachers in learning the latest trends in content, pedagogy and curriculum development in India and abroad in various branches of science. Science practicals and internship programme are the main features of this curriculum.

Every student whether for humanities or sciences, has to study the philosophical and sociological foundations of education; development and problems of Indian education; and psychological foundations of education. The specialization is offered under the content-cum-methods section for science. The teacher trainees have to study biology, chemistry, mathematics and physics, both their contents relevant to the school curricula and methods of teaching these subjects.

Every student is required to offer one area of work-experience as an integral part of teacher training. Experiences in electronics/electricity/woodwork/metalwork/paper craft are provided as a complimentary part of the science curriculum.

In addition to preparing teachers for science subjects through its B.Ed. programmes, the college also offers specialization to prepare teachers for other subjects like commerce, languages, and social sciences.

Socially Useful Productive Work (SUPW) component in B.Ed. training programmes

One of the major educational innovation introduced in the Indian school curriculum is the Socially Useful Productive Work. This is conceived as an educational manual activity contributing towards the total development of the learners personality. This includes the development of the child as an efficient worker with a sense of commitment to the society and personal fulfilment. This would mean that the child will participate purposefully and meaningfully in manual activities. This curriculum area provides children with opportunities to participate in social and economic activities inside and outside the school.

At present all the students of B.Ed. work for 6 periods in a week in one selected area of W.E./SUPW Training in the following areas:

a) Paper Craft;
b) Book Craft;
c) Wood Work;
d) Metal Work;
e) Electricity;
f) Electronics;
g) Gardening;
h) Photography;
i) Commercial Art; and
j) Typewriting.

Theoretical topics are discussed in theory classes while skill development is attempted at in the practical classes. The present scheme only provides work training in one area of Work Experience.

C. In-service training programmes

One of the main objectives of NCERT is to provide a large number of in-service programmes of different durations and different types, based on the felt needs of teachers and teacher educators. The Department of Education in Science and Mathematics conducts summer institutes and also extension programmes in content and methodology not only at Delhi, but also in different parts of the country. The State Governments seek the assistance of NCERT in getting their officers, teachers and teacher educators trained or oriented in different areas of education or educational administration. NCERT conducts leadership programmes all over the country.

In addition to the science education and mathematics department at New Delhi, conducting various in-service programmes in science education, its Regional Colleges also conduct many in-service programmes to update the content knowledge of teachers and promote their competencies.

The Correspondence Education Cell of the College at Bhopal organizes a number of in-service programmes for the teachers and teacher-educators with the academic support of other departments of the College. Three types of programmes are organized by the Cell:

Linking science education to rural environment

i) B.Ed. Course through Summer School-cum-Correspondence (SSCCC)
ii) Correspondence-cum-Contact Course for the Secondary Level Teachers and Elementary Teacher Educators
iii) Short-term Courses organized under the Extension Services Programmes

A short description of each category indicating the nature, scope and mode of operation is given below:

i) B.Ed. (SSCCC)

This course was introduced in 1966 mainly for clearing the backlog of untrained secondary school teachers. The scope of the course was widened later to include school teachers of all other categories.

Admission in Summer School-cum-Correspondence Course is given to those untrained secondary/middle/primary school teachers who have put in more than five years of service after graduation. Fresh graduates are not eligible for admission to the course. Post-graduates in Physics, Mathematics, Chemistry, Botany and Zoology with three years' teaching experience are also eligible for admission to the course.

The total duration of training in this programme is 14 months. This includes two summer vacations of two months each during which candidates are required to stay on the campus of the College for an intensive instructional programme. The College faculty and outstanding teacher educators from various parts of the country are invited to teach in the summer course. The intervening period of 10 months between the two summer courses is utilized for instruction through correspondence and supervised field experiences, including practice-teaching. The College utilises the services of training college staff, headmasters and outstanding trained teachers who are requested to supervise the lessons of student-teachers. They also make an assessment of the work done by the student-teachers i their own schools during this period.

A unique feature of the course is that it provides opportunity for on-the-job training. The course is in great demand by the serving teachers.

ii) Correspondence-cum-Contact Programme (CCCP)

Two types of courses are organized under this programme. In the first category are those courses which are meant for secondary school teachers who are teaching various subjects to classes IX and X. The second type of courses are designed for the elementary teacher educators who are given enrichment courses in various academic and professional areas keeping in view the needs of primary level. The mode of organization of the courses is through correspondence lessons for 6 months and contact session of two weeks.

(a) For secondary school teachers

As the Government has now introduced a 10+2 pattern of secondary education, it was thought that the successful introduction of this new pattern would depend upon the professional competence of the secondary stage teachers who would be required to teach the newly added science content at the high school stage and, particularly in the +2 higher secondary stage. This training programme is designed primarily to help the existing secondary teachers, if necessary, to handle the +2 stage curricula.

The topics for correspondence lessons have been chosen in such a manner that only those content areas are covered which have their relevance to the 10+2 secondary school curricula. The subjects included in the content correspondence for science are: 17 lessons in physics and 13 lessons in chemistry; 46 lessons in biological science; and 8 units in mathematics. During the two week contact session, extensive discussions are held on the topics covered through correspondence lessons. A good amount of practical laboratory work is also done by the teachers.

(b) For elementary teacher educators

This course has been started with a view to improving the professional competency of the teacher educators working in the elementary teacher education institutions. At present almost all the teacher educators working in these institutions were trained in secondary level teacher training colleges. As such their professional training is not relevant to their current responsibilities. Through this course an attempt has been made to orient them about modern trends in elementary curricula; problems, organization and supervision of elementary education; and child psychology. In addition to this enrichment programmes in Hindi, Social Studies, Mathematics and Science are included.

iii) Short-term Courses organized under the Extension Services Programmes

Programmes of this category include short-term courses, seminars, conferences and workshops in the areas which are either suggested by the State Departments of Education or proposed by the faculty members of the college keeping in view the in-service needs of teachers and expertise available in the college. A number of programmes are organized every year by the Correspondence Education Cell with the academic support of other Departments of the College. In the last academic session, 16 in-service programmes were undertaken. Of this, 9 courses were for the secondary school teachers, 3 for elementary teacher educators, 1 for field workers of non-formal education, 1 for the teachers in graphic arts and 2 for resource persons of Centres of Continuing Education. The duration of the programmes varied from a 2-day conference to a 2-week workshop.

Hoshangabad Science Teaching Programme

Friends Rural Centre and Kishore Bharati, which are two independant voluntary agencies involved in the field of rural education and development, in 1972 jointly initiated a science education programme in 16 middle schools spread over two development blocks of Hoshangabad district in the State of Madhya Pradesh.

From the very beginning of this experiment, the significance of utilizing the human resources of the universities, colleges, and higher secondary schools was fully recognized. The initial impetus for the programme was given by groups from the All India Science Teachers Association and the Tata Institute of Fundamental Research, Bombay. This original combination was later joined by a group of faculty members and research students from the University of Delhi which took upon itself the entire academic responsibility. The Delhi group received official support of the University Grants Commission to participate in this programme. The government of Madhya Pradesh also permitted some of its post graduate college teachers to participate in the programme on a regular basis. A positive and significant result of this University-College-School interaction is the gradual breakdown of the elitist character of the institutions of higher education, thus preparing conducive ground for initiating relevant changes in their own objectives and programmes. The project also provides a unique instance of a State Government accepting the role of voluntary agencies in changing school education within its own framework. It is a unique experiment to explore the limit of educational change within the existing framework to make education more relevant to social and economic needs.

The programme undertook to investigate the feasibility of the 'discovery approach' and 'activity-based learning' of science under rural school conditions. In the course of time the concept of environment-based learning was also included. The Department of Education of the Madhya Pradesh Government played a special role by extending much needed administrative backing and academic freedom to this voluntary group to experiment with new books, kits, curricula, teacher training and examination methods. The project has made much head-way during the last six years and the experiences and insights gained in the experimental phase when the project was confined to only 16 schools have now been spread to cover all the middle schools of the district.

The science content (syllabus), included under this programme, is the same as is being followed in the other schools of the State at the middle school stage. However, the difference is in terms of learning/teaching methods, nature of the instructional materials, role of a teacher and evaluation procedures.

The learning/teaching strategy is based on the belief that children learn science primarily by arriving at conclusions through experiments, field trips, observations, data collection, interpretation of their results in the form of drawings and graphs, and finally by analytical discussion under the guidance of teachers.

Special emphasis has been placed on the utilization of the environment as a rich source of learning. A system of field trips to agricultural fields, rivers, rocks, forests and the village has been evolved and tested. Biology is primarily learned through this method.

For the instructional materials, a complete set of workbooks has been developed and subjected to extensive trials and revisions. The workbooks do not give facts, definitions or information as is generally found in science textbooks but instead give only the instructions for performing experiments and for conducting field trips. This is followed by a set of questions. The content covered by these workbooks has been examined by the government textbook committee and found to be equivalent to the materials covered in the traditional curriculum which is being followed in other schools of the State and hence the State Textbook Corporation has been authorized to publish these workbooks.

As the whole approach to learning teaching under this project is 'discovery-based' and 'activity-based', a simple kit has been developed to enable the children to conduct experiments in groups of four each. Approximately one-third of the kit is constituted of items collected from the villages itself. The kit is not merely a demonstration kit but an activity kit so that the students could have the first-hand experience themselves. For a village size middle school (classes VI to VIII with 40 children per class), the initial cost of kit is about US$100.

The in-service training of teachers constitutes a major activity under the programme. The Hoshangabad Science Teaching Group (HSTG) has developed a methodology of training the teachers. The role of follow-up in teacher training programmes has been fully recognized. Experience gained in the project has shown that the training programme without a substantial follow-up component is likely to be a wasteful exercise. Regular follow-up, involving both school visits (on an average twice per month) and monthly meetings with teachers is necessary not only to assist them but also to collect feedback from the classroom which becomes the basis of all future planning and material development.

With the expansion of the project and to cope with the task of providing in-service training to teachers of all the middle schools which have now been included in the project, a 'Resource Group' and an 'Operational Group' have been set up. The operational group, which has about 100 teachers drawn from local higher secondary schools and colleges, is responsible for regular school follow-up and collection of feedback data from the class-rooms. An academic cell has also been established in the Regional College

of Education, Bhopal, to analyse the collected data and utilize it for further improvement of the project. Another organizational innovation is the setting of 'Peer Teacher Group' of selected middle school teachers out of those who had received training and had gained enough experience in practising the discovery approach for the last few years, under this experiment. The members of the group assist in the teacher training and school follow-up programmes around their respective blocks.

As examinations continue to have a very powerful influence on the school programmes, a new approach to examinations is being developed under the project. It is recognized that traditional examinations mainly test the students capability to memorize and recall facts from books or teacher dictated notes. The Hoshangabad experiment emphasizes the qualities of independant observation, data collection, free thinking and logical deduction. It seeks to test the extent of the child's readiness and ability to innovate through physical experimentation when faced with a new problem. It feels that the traditional testing procedures, including the so-called 'objective tests', are basically incompatible with the aims of learning science through the discovery approach. This contention has been accepted by the State Government which has given the project the freedom to evolve and execute its own examination system. Earlier attempts at educational change by voluntary agencies have failed precisely when the government did not recognize the incompatibility of the traditional examinations with the new approach.

Last, but not the least, the importance of giving greater participation and responsibility to local community has been fully recognized as the means of improving administrative and academic performance of the village schools. The Project has offered a unique opportunity to undertake a field-based testing of the concept of decentralization.

The visit to this project and to a number of schools in remote areas where it is being implemented, ended with a discussion session with Education Secretary, Government of Madhya Pradesh and Joint Director, Science Education. The Seminar was briefed on what the major innovations in the State are being focused on:

i) Non-formal education for children of age group 6+ to 14+

The programme is designed to meet educational needs of children who have dropped out of the primary schools or who have never been to schools at all. The main features of the programme are: flexibility in regard to the venue and timing of the non-formal education centres; provision of mid-day meals; free distribution of textbooks and writing materials; free supply of equipments; different kinds of curriculum and use of different materials according to the felt needs; and intensive in-service programme for teachers.

ii) Non-formal education for girls

Four out of five girls are illiterate in the State. The programme attempts to encourage girls to undergo education. The innovative features are: information was elicited from parents about the type of education they would need for their girls which was identified as reading and writing of letters; reading of an epic like Ramayana; and some aspects of home science, like preparation and preservation of pickles. Courses are now being developed to cater for such needs.

iii) Adult education

Government has given top priority to this programme in its Sixth Five-Year Plan. The innovative features are: the programme does not concentrate only on literacy, but emphasizes development activities with education as the pivotal point so that the adult can see the economic gains for himself through education. Occupational skills and productivity are two important components of this programme.

iv) Science teaching programme

The Government has followed the progress of the Hoshangabad Science Project very closely and, in view of the gains made, has now taken up the full administrative responsibility for its wider implementation. The government recognizes that the unique feature of the project was the support that it received from organizations like Tata Institute of Fundamental Research, All India Science Teachers Association, University Grants Commission and Delhi University, Colleges of Education in Madhya Pradesh and recently from NCERT which has already established an academic cell in its Regional College of Education at Bhopal and also provided financial assistance for supplying kits. The supervisory staff of the Department of Education is now fully involved in the implementation of the programme. It was, however, pointed out that for a further expansion, certain problems are likely to arise and solutions for these will have to be worked out. Some of these problems are:

a) With the increase in the number of schools, the problem of maintaining the quality of instruction at the same level as is being done in the schools under the project at present would arise.
b) The materials prepared sometimes tend to be serving the needs of urban population rather than rural as most of the experts who prepared materials are from urban areas. For the success of the project, the teachers role is most important and unless they have zeal and competence no project can succeed.
c) Arrangements for intensive in-service training will have to be made to cover all the teacher population and this involves major problems of finance, management and administration.

Science Education Programme in Delhi State

Science education at all levels of school education in Delhi is being planned, organized, implemented and supervised by Science Branch/Institute of the Directorate of Education, Delhi.

The Science Branch comprises of an Institute of Science Education and three Science Centres-cum-Central Workshops located in each of the educational districts of the Directorate of Education. The Science Branch/Institute has various academic and Research Units which plan and develop new techniques, improved methodology and curriculum for all levels of the school education. Each of these units has major responsibility of working out and implementing science education schemes for effective supervision and guidance to the teachers and principals so as to improve the existing facilities, making teaching-learning situation more effective and undertaking follow-up and research work with respect to the various new projects within the specific field of work assigned.

Each Science Centre functions as an extension cum continuing Science Education Centre for science teachers and a nucleus for student activity (Science Club). Besides this, the supervision, guidance and improvement programmes for the professional growth of teachers is one of the most important activities of the centre. Seminars, workshops and short refresher courses highlighting new trends in content and methdology of science subjects are held in various subjects to prepare and equip the teachers for modernizing classroom instructions and laboratory work. Experts for conducting such programmes are drawn from different scientific research organizations, college and university science faculties.

With the introduction of 10+2 pattern of education in Delhi from May 1975, work experience has been made a compulsory subject at the secondary stage. At present following ten science based work-experience courses, namely, Electric Gadgets, Electronics, Photography, Gardening, Crop Production, Basic Engineering (Wood Work), Basic Engineering (Mechanical), Spinning and Weaving and Household Gadgets, have been introduced in classes IX and X. As a result of the scheme of diversification at +2 stage, vocational courses have been introduced in selected schools and provision has been made for science based vocation courses in Basic Electronics Technology, Basic Electrical Technology, and Air-Conditioning and Refrigeration.

The planning, co-ordination and supervision for these is the responsibility of the Work Experience Cell of the Science Branch.

The participants of the Seminar were able to observe the following:

Visit to schools

Two schools, one government managed and the other a privately managed were visited. Both the schools are affiliated to the Central Board of Secondary Education and follow the curriculum

prescribed by it. The government school had the basic facilities for science teaching and children are frequently engaged in laboratory work in batches. The nature of laboratory experiences observed, however, tended to be of a routine and very traditional type. The programmes of vocational subjects observed in the school were of a high order.

The public school had much better physical facilities but in view of high tution fees, the admissions tend to be restricted to families of higher income. The science laboratory work here also appeared to be of the same traditional type. This is perhaps due to the constraints imposed by the requirements of the prescribed syllabus. The work experience activities offered by the school were very rich, meaningful and varied.

Science Centre, Vasant Vihar

A very impressive project is the maintenance and repair of school science equipment carried out under the Central Workshop of this Centre. Under this project the schools served by this Centre have the facility of getting their equipments repaired through the repair workshop of this Centre. The arrangement has led to a considerable saving of financial resources as well as has ensured the availability of working equipment in the schools so that practical laboratory work is not hampered. The staff of this project also periodically visits the shcools, examines the equipment and advises the schools on maintenance problems and provides on-the-spot training on minor repair works.

Investigatory Science Projects

A recent innovation has been the inclusion by the Central Board of Secondary Education in the +2 stage science syllabus of an investigatory science project as a course requirement. The students have been given an option in the matter of selecting the investigatory science project but it is expected that the science teachers will encourage the students, particularly with the scientific bent of mind, to take up such a project. The various steps involved in the project are: observation leading to a question; further observation and gathering of relevant information; formulation of an explanation into a hypothesis; statement of a working hypothesis; testing of hypothesis through experimentation; interpretation of data, resulting in either acceptance of the hypothesis or its modification or its rejection. A variety of projects were being investigated by the students in the science centre in a workshop situation where facilities for such work are available. Discussions with supervisors indicated that this approach has been very helpful in developing the creativity, and interest in science learning amongst the students as well as a motivation for teachers to further improve their own knowledge and competence. The product of many of these projects also find place in annual science fairs, another important activity which the Science Branch organizes every

year contributing to public understanding of science, as well as motivating a large section of student population to undertake such investigatory activity.

Subject teachers circles

In order to assist the teachers in handling new topics and modern concepts that have been introduced in the +2 secondary stage curricula, the centre organizes these subject teacher circles where experienced teachers share their experiences with their colleagues teaching the same subject. Resource persons drawn from tertiary institutions assist the deliberations of these circles for clarifying the new concepts and making available the latest information on topics under discussion. The chemistry meeting which was observed, demonstrated the effectiveness of this approach in upgrading the content knowledge of the teachers. However, it was felt that such approach could perhaps be used only in larger cities with cheap and quick facilities available for commuting distance between schools and site of such meetings. Being of a voluntary nature, it demands a great motivation on the part of a teacher for his own professional growth.

Institute of Science Education

This is located in the headquarters of the science branch. The participants had an opportunity to discuss with the research staff the findings of a project on primary science and cognitive development of children, results of which have been used for improvement of instructional materials. An in-service training programme for primary teachers for introducing the newly started environmental studies programme provided a good example of the use of environment and low-cost and indigenous materials in developing science experiences.

Chapter Four

SYNTHESIS OF EXPERIENCES

This synthesis was done, keeping the objectives of the Seminar in view. A matrix was developed to serve as guideline for analysing and integrating the experiences of the team.

It must be pointed out that the constraints like lack of time for longer and fuller discussions and limited exposure to certain projects were felt by the members of the Seminar. The members request the readers of this report to have an open mind to the above constraints, if full justice has not been done to all the projects visited in the Philippines and in India, and if there are any omissions and commissions.

The members of the Seminar were very much impressed with the efforts that are being made in both countries to improve the quality of science and technology education through various innovative activities in the field of curriculum design and development, pre-service and in-service programmes, research, invetigatory projects at school level, involvement of the community, use of environment and production of low-cost instructional materials, including textual materials and prototypes of simple science equipment and kits. The major emphasis of the various projects visited was on linking science learning to daily life experiences and environment, thus bringing in the element of relevance. Some of the salient features of the observations of the team are as follows:

PHILIPPINES

1. Community-based Projects

A harmonious combination of non-formal and formal approaches and involvement of the community and its resources, both human and physical, are the highlights of the projects. The team was particularly impressed with the project based in a fishing community because of the concrete results that have been effected. The methodology that has been used in this project for the development of a curriculum and related instructional modules has shown positive results, and hence basically the same approach is being used in the development of similar programmes for coconut and abaca growing communities.

This experience has great relevance for other participating countries of the Seminar, for designing their own programmes to develop the much needed scientific literacy base for various development activities.

2. Science Curriculum Development Programme

If effective and meaningful curricula are to be developed, the need for having an institutional infrastructure such as UPSEC in the Philippines and NCERT in India, is fully reflected through the various science education projects observed. Equally important is the need for a sound research base for any curriculum design and development effort. The WISP and evaluation of physics textbook were two good examples observed. More and more of such activities need to be built in curriculum development efforts.

3. Development of Teachers' Resource Materials

In the in-service training programmes, there is a marked shift from course-based training programmes to competency-based ones. The teachers' resource materials which are linked to the environment and are competency-based are developed and tried out in a workshop for feasibility. Such a project can be expanded to include more use of local resources in the communities concerned.

4. Pre-service Teacher Training Programme at the Philippine Normal College (PNC)

The B.S. Physics for Teachers (BSPT) and B.S. Maths. for Teachers (BSMT) programmes demonstrate an approach of ensuring the availability of well qualified and gifted students in science and mathematics for teaching of these subjects in schools. To ensure that the products of these programmes are strong and competent in their area of special subject specialization, the concentration on the major courses is as rich as in those offered in regular Bachelor of Science degree programmes of science faculty. This has been achieved by reducing the education or professional courses to nearly half of what are offered in other teacher training programmes. To ensure development of teaching skills, there is a provision for one quarter of internship in a selected high school for actual teaching of the major course. Another major innovation which deserves mention is the concept of developing the PNC consortium with De La Salle College through which arrangement of the BSPT and BSMT classes are conducted on a team-teaching basis. The course also requires students to do a special research and investigation which is a good way to introduce future teachers to the ways of working of a research scientist.

The programmes use a novel method of teacher training where local expertise in the RSTCs acclimatize aspiring teachers to actual teaching environment in the rural setting during the summer internship programme.

The Bachelor of Science in Elementary and Secondary Education (BSESE) is an innovative way of providing teachers who can teach both at elementary and secondary levels. This programme could be particularly helpful for providing teachers in the rural areas of developing countries, and needs to be evaluated and followed up carefully.

5. Vocational Training of Teachers and Technicians at the Technological University of the Philippines

The various university programmes offer a good example of formal and non-formal education approaches with a heavy bias on vocational education.

The certificate and diploma courses are good vocational programmes for producing industrial arts teachers for elementary schools. Apart from running regular certificate, diploma and degree programmes, it is commendable to note that the university is also conducting evening classes that provide working students with an opportunity to upgrade themselves.

The training in bakery and tailoring is a good model to follow as there is a close liaison between the university and industries in training people with occupational skills.

6. RSDCs: University of Santo Tomas

The RSDC-DLRC local schools scheme is a good example of an organization system to promote the professional growth of a large number of teachers all over the country through a wide network of centres having a multiplier effect.

The organization is a model worthy of study in terms of covering a large number of teachers. However, the effectiveness of training at DLRC level has not been as yet tested because evaluation is still being undertaken. The team is apprehensive about possible dilution at the DLRC level, unless mechanisms are developed to minimize the transmission losses.

7. Baguio Vacation Normal School

The main incentive for the various training programmes offered by the school is that they lead to credits. The follow-up of the training programmes is difficult becuase of the limited number of staff members.

8. UPSEC Short-term Training Programmes

This is a measure for continuous upgrading of teachers, catering to their particular needs. Instead of taking the whole spectrum of scinece education, there is concentration on a particular aspect according to the need of the teacher. Such an effort needs to be extended to the Regional Science Teaching Centres also.

INDIA

1. Environmental Studies for Primary Level at NCERT

This is an innovative project because: (a) it is environment-based with the child as the nucleus; and (b) the approach is a complete departure from the approach used in the previous materials in the sense that the social component and science are interwoven in

the presentation of units. The relevance of science learning to problems of real-life and rural environment is very much visible. The emphasis on use of environment and low-cost materials is another strength of the programme.

2. Integrated Materials for Classes VI, VII and VIII

Concerted efforts have been made to integrate the different fields of science in one course. This is commendable because the natural environment as perceived by the child is not compartmentalized into biological and chemical components. However, the team feels that there is a need for identifying a more effective integrating factor: in terms of structure or discipline? in terms of situational factors? processes? consideration of a topic around which chemistry, physics, biology can be developed?

3. Projects on Supplementary Materials

i) Science teaching films

The role of films for providing certain science experiences, which otherwise may be difficult to bring into the classroom situations, cannot be over-emphasized. Films such as the one observed by the participants on 'Animals', their adaptations and habitats, is an example of how teaching of biology can become more meaningful and exciting for the students. Other films developed for use in training programmes, particularly for primary science, show the possibility of using the mass media for training a large number of teachers prior to the introduction of any improved curriculum. The close association of curriculum developers in the preparation of these films needs to be underlined.

ii) Supplementary reading materials

Textbooks continue to be the main source of information in our schools. There are many limitations of the textbooks. Gifted children or those who are interested in knowing more about certain scientific principles need other sources of information and the type of supplementary reading materials that are being developed is an answer to this problem. What is important in this project is that leading specialists of the country in a particular area have been involved in the preparation of these supplementary materials.

Good work is being done in producing enrichment materials. More films in science and technology should be developed pertaining to real-life situations and the environment.

4. Science Education Centre at New Delhi

The mobile team is impressed with the variety of activities in science learning made available to students and teachers. It gives an incentive to both target groups for upgrading themselves. This is another example of how the development of an institutional infrastructure can ensure proper development and implementation of

improved science education programmes. The important role of supervision and constant help to the classroom teacher with new ideas through a variety of training programmes appears to be one of the most important strengths of the various activities observed by the team. The team, however, feels that the compactness of the area covered by these Centres and the facilities of communication that are available has gone a long way in the successful implementation of the various programmes.

The introduction of investigatory type of projects as a course requirement deserves special mention and can be profitably used by participating countries in their own secondary science education programmes.

5. Hoshangabad Science Teaching Project

This project has been dealt in greater detail in Chapter III of this report. The project is noteworthy for the following reasons: (a) the course is activity-oriented, marked by synchronization of theory and practical; and (b) use of improvised low-cost materials is recommended and prototypes have been developed for this purpose.

It is to be noted, however, that the major input to this project was provided by a group of scientists from research and tertiary institutions, a strategy which has to be encouraged if similar programmes are to be developed in other participating countries. Local expertise in the form of establishing 'operational groups' and 'peer teacher groups' for supervision and training needs is increasingly now being used. Topics, taken up in other community development programmes can be developed into learning units for use in schools to relate what is being learned in the non-formal setting to the learning inside the classrooms.

6. Bhopal Regional College of Education

The 'Socially Useful Productive Work' training activities (SUPW) programme being undertaken by the teacher trainees will provide them with practical skills for teaching any subject. For example, such skills will be useful in preparing visual aids, improvised materials, prototype equipment. The programme can also develop a positive attitude towards work on the part of the teachers.

There is a lot of science in the different activities observed. Science can also be brought into the picture instead of mainly emphasizing skills development. Incidentally, this recommended strategy can be undertaken also for the SUPW done by the children in their classrooms, and using it as a vehicle for science teaching-learning.

Linking science education to rural environment

The correspondence course (in-service training programme) offers an opportunity for reaching a greater number of teachers. Incentives and requirements will have to be built into the programme to motivate the teachers. There is need for careful study of the suitable instruments to measure gains. The materials could be modular so that the teachers can pick up the particular topics according to their needs and interests.

There is need to try out different modalities of training, e.g. 2-year, 3-year, and 4-year programmes, which will answer the demand for better trained science teachers.

Chapter Five

PARTICIPANTS' REFLECTIONS FOR IMPROVING THEIR OWN PROJECTS

AFGHANISTAN

As stated above, I am at the initial stage of developing science curriculum and instructional materials for elementary and secondary schools, and have to identify new strategies and approaches in the areas of curriculum development and teacher education which would be more meaningful for my country. Therefore, experiences gained through the Mobile Field Operational Seminar have come at an opportune time, and have been most beneficial and informative through direct participation in observations, discussions, investigations and other activities.

I observed classrooms in almost all grade levels in some elementary, secondary schools and teachers colleges in the Philippines and India. In some of these classes, students were divided into groups, and teachers were trying to individualize instruction to meet varying needs, whereas in some other classes, teachers used a lecture method. Though it is the State Department of Education which prescribes certification rules for teachers, decides the textbooks to be used in the schools and also determines the state goals of education, I was able to see a number of attempts to develop a decentralized system of education in practice in the Philippines and India. The teaching materials used at the elementary level were mostly integrated science, while at the secondary level, mostly discipline-wise science subjects were used, an approach which we are also trying to develop.

Briefly, I have to mention that the concept of teacher education and curriculum development in Afghanistan is more or less similar to those in the Philippines and India. As far as facilities and resources in both countries are concerned, they are very different from those available in the schools in Afghanistan. It is, therefore, obvious that the teacher education and science curriculum and instructional materials from the two countries will not be transferable to my country or any other developing country; but the experiences through direct participation and activities have provided me with greater insight and depth of understanding about science curriculum development and teacher education from which I will be able to extract certain strategies and methodologies more relevant for use in my country. 65

Linking science education to rural environment

INDIA

The roles of a Field Adviser, NCERT in States in India, a position in which I am working are:

1. Liaison officer between the National Council of Educational Research and Training (NCERT) and State Departments of Education;
2. Liason officer, Ministry of Education, Government of India, with the State Department of Education;
3. Organizing in-service programmes in the State, for teachers (primary to +2 level) and teacher educators according to the advice of a Programme Advisory Committee, consisting of top-level officers of State Department and eminent educationists;
4. Disseminate innovative ideas and spread good practices in the field of education to promote quality in education, as an ex-officio member of various Boards of Education constituted by the government; and
5. Act as director/resource person in seminars and workshops.

In the light of the above functions, and experiences and insights gained during the Seminar, I would like to incorporate the following aspects in my area of work:

1. The rural areas in India cannot afford to have separate teachers for primary and secondary levels, specially in small rural schools. I can bring to the notice of Boards of Education the innovative programme of teacher training in the Philippines (B.S.E.S.E.) which is an integrated single programme preparing multi-purpose teachers;
2. I will bring to the notice of the State Department of Education the curriculum development strategies adopted by the Science Education Centre, University of the Philippines, at Manila, with particular reference to: (a) community-based projects; (b) vocabulary studies; (c) development of instructional materials; (d) in-service programmes; and (e) assessment of needs of the community and establishing a rapport between the community and school;
3. State Educational Research seeks the advice of the Field Adviser quite often in institutional planning and in conducting in-service programmes. Some of the programmes of DLRC and RSDC in the Philippines have many desirable implications for the State programmes, and I will try to influence the thinking of the Department on some desirable aspects;
4. Hoshangabad Science Teaching Project is an innovation worthy of replication with suitable adaptations in the Karnataka State also. I will discuss with the State authorities and explore the possibility of implementing a similar project; and

5. I will bring to the notice of the teachers through seminars, workshops and meetings, the new techniques and strategies adopted by the teachers in other countries.

JAPAN

The Seminar gave an opportunity for exchanging views and clarifying major issues and problems related to the development of science curriculum and teacher training programmes. Some of the significant features observed and experiences gained during the Seminar which can be profitably used in Japan are the following:

A. Philippine experiences

1. It was noted that there is a very close co-operation in developing and implementing science curriculum activities among different people such as curriculum developers and specialists in the development of instructional materials, university professors, education authorities and teachers' associations. The following are some of the interesting features which could very profitably be incorporated in similar work in Japan also:

a) People from different agencies and with different backgrounds and disciplines in the field of curriculum development work closely together to develop science education activities for achieving the same purposes;
b) In spite of the involvement of various people in the development of science curricula, it seems that they have no difficulty in communicating with each other using the same terminologies. This heterogeneous nature of the composition of group is surely contributing to the development of a meaningful and relevant curriculum, ensuring the use of different methods and approaches;
c) It is worthwhile to note that teachers, university professors and educational authorities are all very active and contribute to the implementation of new projects on science education.

2. The project on "Words in elementary science and mathematics (WISP)" is of particular interest. The main objective of WISP may be worth noting here:

a) make a list of non-technical words needed by grades IV-VI pupils to learn science and mathematics;
b) provide information about the extent of the vocabulary of pupils in grades IV-V and VI for use in the list of non-technical words.

As this project is aiming to link language education and science education for facilitating the understanding of science concepts, this type of project could be of much interest in Japan.

3. The National Research and Development Centre for Teacher Education is conducting a study on the tasks and skills required of teachers in national development. This type of study is very important and should be encouraged. Philippine experiences show the importance of teachers' participation in the development of instructional materials in order to bring in the element of relevance as well as to tackle the problems such as the lack of teaching materials in schools. In the Philippines, various projects emphasize the encouragement of teachers to develop teaching materials out of locally available resources. In this connection, it may be noted that the training of teachers in the preparation of teaching materials should be more emphasized in Japan.

B. Indian experiences

1. Developing integrated science curriculum for elementary and secondary levels of education is in the process of development. It is done by teaching different science subjects around the following aspects: a) environment; b) concepts; c) topics; d) processes. The approach of integrated science may give a rich experience to children to look at various phenomena and events from different viewpoints and angles, and specially for developing in them the care of the environment and love of nature, a concern which has much relevance for Japan.

2. Collaboration among curriculum experts, instructional materials experts and teacher training specialists is of a very high order. This kind of very close collaboration among people in different disciplines and fields, if developed everywhere, will enrich the contents of the curriculum.

3. Activities of the Delhi Education Directorate's Science Centres are very functional as they provide in-service teacher training programmes, particularly in the development of simple experimental aids which may be easily developed even in the rural areas. The idea of developing simple teaching aids from local resources is an emerging trend, and this approach will surely enrich the children's learning in classrooms. The programme of encouraging investigatory projects by students is positively contributing to the development of children's creativity and needs attention.

C. Overall observations

In view of the experiences gained in the Philippines and India, the following three observations may be made:

1. The activities of curriculum development, the development of instructional materials and teacher education should be linked together in order to cope with the difficulties and problems faced by the countries. If specialists involved in these activities can look at programmes/activities from different viewpoints based on their specializations, this interdisciplinary approach may serve in solving complex problems.

At the international level, the sharing of experiences through personnel exchange, meetings and seminars like this Mobile Field Operational Seminar should be further arranged.

2. More practical subjects/topics should be introduced at the elementary school level. It may be necessary to introduce very practical topics/subjects like health and nutrition in classrooms. Apart from basic skills and concepts, very practical information especially for daily life should be taught. If the school can provide such practical knowledge and information to the students, it may ultimately help reducing the number of drop-outs.

3. It would be necessary to activate teacher activities through the organization of teachers' associations or study groups for planning and implementing science curriculum activities. If the teachers are involved in this process, they would have a greater awareness of the current needs and trends, and newly designed curriculum may easily be adopted by the teachers. This may reduce the teachers' resistance to centralized curriculum and also serve to develop a high degree of motivation among teachers.

MALAYSIA

As the training of teachers is my current main responsibility, and based on the experiences gathered during this Seminar and experiences of my own country, the following suggestions have been made to improve the pre-service programmes for science teachers.

More than a decade has since passed when many developing countries undertook to reform and innovate the teaching and learning of science in the elementary as well as in the secondary schools. Programmes of these reforms and innovations are often spearheaded by respective curriculum centres or units. In accordance with the educational structures of the respective countries, the curriculum materials, when introduced for use in schools, often require much effort and high expenditures in providing the necessary retraining of teachers to enable them to use the materials effectively. Moreover, the necessary software and hardware materials required for effective teaching and learning in respect of the programmes have to be produced and made available not only in quantities but also on schedule for use by the schools concerned in order to implement the new programmes. These are some of the concerns confronting curriculum innovations, as observed in the two countries visited. The successful implementation in respect of an innovative programme thus calls for detailed planning, and the necessary logistics have to be charted out for implementation and management of the reform.

In view of the massive manpower, high expenditures and time constraints in effecting curriculum changes, it may therefore be useful to plan in advance to have teachers prepared for curriculum changes pertaining to various philosophies and approaches. This

is considered necessary, since the proper and effective implementation of any new curriculum depends largely upon the extent of the training and orientation of the teachers to it as they are, in the final analysis, required to transmit it to the children in the classrooms. In addition, such teachers could further enhance the efforts of curriculum centres/units in curriculum innovations from time to time.

With the numerous science curriculum materials now available both from developed and developing countries, in-depth studies of some of these science materials in pre-service training of teachers may enable the trainees to understand in concrete terms various possible approaches to teaching and learning of science topics based on themes or philosophies such as conceptual approach, process approach, enquiry approach, environmental approach. Such in-depth studies would not only enable a trainee to appreciate the salient features and emphasis given in the respective approaches, but would also enable him to understand the possible ways in which he may adjust teaching-learning approaches from one form of emphasis to another, depending on the requirements of the day or the constraints faced due to facilities or localities. Furthermore, such in-depth studies would provide the trainees with the background experiences whereby any future changes in emphasis of curriculum materials in their teaching career could easily be understood and assimilated by them, and extensive and intensive in-service training relating to the new curriculum could be reduced to a minimum.

Another feature which may be worthy for inclusion in a pre-service teacher training programme is curriculum writing and development. Apart from enabling the student to understand fully the efforts behind the various curriculum materials while making in-depth studies of them, training and experiences in curriculum writing would also provide him with the know-how in producing some of the necessary curriculum materials by himself and for himself, taking into consideration the local constraints and facilities, to complement and supplement existing ones for more effective teaching and learning in the classroom. Teachers who have undergone such training and experiences may constitute the potential pool of manpower which may be called upon to assist in curriculum reform and development as and when changes in curriculum are felt to be necessary by the country concerned. Viewed from another angle, such teachers may not only be entrusted as agents of curriculum changes, but also be able to spearhead changes in curriculum reform at the classroom level.

For teachers who have undergone training without such experiences as in-depth studies of various curriculum materials, curriculum writing and development, in-service courses may be planned concertedly for them so that large gaps of experiences may at a point of time be bridged for all the teachers.

NEPAL

The following are some of the experiences which, to my mind, would help considerably in improving our own programmes of curriculum development and teacher training:

1. Strategies and methodologies being used in the projects on developing instructional materials for integrated science curriculum observed in NCERT and UPSEC could be best utilized for the community development in Nepal. This will help in improving the socio-economic life of the villagers, because:

   a) the concept of science will be presented as a whole, instead of compartmentalization;
   b) the formal contrived situations can be replaced by the students' own immediate environment, and the activities can be performed in the school as well as in his home; and
   c) the curriculum is student-centred and has a built-in motivation, as it is linked to their real-life situations and environment.

2. In the development of textbooks and other instructional materials, the care taken on the language and comprehension ability of the child is appreciable in NCERT materials. Similarly, a project as done in UPSEC, in the vocabulary study of non-technical terms made under projects of WISP and WELS, can be of considerable help in facilitating the understanding of science concepts.

3. The use of the waste products or used materials for preparing teaching aids are the most important projects I have seen in India and the Philippines. The projects can be of great interest in our country because we have been trying to use a great deal of low-cost simple materials as instructional aids.

4. The in-service programme in the Regional College of Education, Bhopal, and the RSDC programme in the University of Santo Tomas, Philippines, are noteworthy. These programmes will help in updating the teachers' content knowledge and promote their competencies.

5. The community-based projects observed in UPSEC, Philippines, are very outstanding for the development of the rural areas. Of course, the project selection might be different in Nepal. Agriculture being the major part of our economy, a number of projects on agriculture and forestry can be developed as have been designed in UPSEC by following the methodology used in the projects.

6. The B.S.E.S.E. (Bachelor of Science in Elementary and Secondary Education) programme launched by the Philippine Normal College, Philippines, can be very useful for Nepal because this programme could help provide a solution towards meeting the shortage of teachers, particularly for rural high schools which are small in size and cannot afford employing too many teachers.

Linking science education to rural environment

PHILIPPINES

In as much as my responsibility at the UPSEC includes development of curriculum materials in science at the elementary level and in-service training of science teachers, the projects which have direct relevance to my work are the following:

1. Environmental studies project at NCERT. It uses a highly innovative approach which synthesizes social studies and science in one course, with concomitant development of language skills. Topics for the production of learning units are not based on content; rather, these are derived from the environment.

Our work-group at the UPSEC is in the process of gathering the baseline data for the next cycle of science curriculum materials for the 1980s. I will suggest a thorough study of the NCERT environmental studies materials to find out how the strategy/topics can fit into our framework.

2. Correspondence course at Bhopal State College of Education. This strategy can be adopted in our short-term courses in order to reach the teachers in far-flung areas who cannot take advantage of the regular courses. However, there is a need for a careful study of the economics involved, and the kind of assessment to be given to the teachers.

3. Science education centre of the State of Delhi. The centre offers a wide range of activities for both students and teachers of science. Most of these activities are being undertaken at the UPSEC and the RSDCs. One service that will be very helpful to the teachers is the repair of science equipment. For the students, research work under the guidance of a competent teacher can further stimulate their interest in science. I will present the scheme of operation of the Delhi Centre to the RSTCs for their consideration.

4. Technological University of the Philippines (TUP) programmes. There is much science involved in the technical courses of this university. In the same way that there is constant interaction between the PNC (teacher's college) and the UPSEC (as a curriculum development centre), a similar interaction can be done with the TUP which will be of mutual benefit to the two institutions.

SRI LANKA

Community development projects

The Mobile Field Operational Seminar has given an opportunity to experience the varied and novel approaches used by different countries to make education meaningful, both to the literate and the illiterate. The literate are taught to be more considerate in using the natural resources, and the illiterate to make better use of their resources. This was highlighted in the project that has

been launched by the Science Education Centre in Manila, Philippines. This community development project aimed to educate a fishing community to practise better health habits, hence avoiding the pollution of their own environment, and also to improve their income by giving them better methods of making and using fishing nets. This is a commendable effort. It is akin to the project under which the senior secondary students of a rural school in Sri Lanka improved the living conditions of a community in a village close to that school. This community which use the cover of nearby bushes to answer calls of nature day in and day out, was encouraged to use water-sealed latrine. This practice brought to them almost immediate benefits, for they found that the medical attention their families required decreased considerably, reducing expense and anxiety. Both these projects were successful because there were immediate benefits to the communities concerned. Other such projects in the Philippines did not register a measurable success because the strategies used and the approach employed did not bring immediate benefits to the communities involved. Hence on these experiences, one could say that the strength of a community development project lies in the benefits and how soon the community gets them.

Visits to schools

At Bulasa Elementary School in Manila, Philippines, an opportunity was provided to us to observe some classroom teaching. The general impression one could get was that all the teachers had come prepared for their particular lessons. A technique used by a teacher to explain the ill effects of population explosion was very striking. Here the teacher marked a certain area of the classroom, called two students and asked them to stand in the marked area. She then distributed two biscuits to them, and called two more students to the same area and asked them to share the two biscuits. This process was repeated and the students soon realized that the area marked could not hold more than 12 students and by that time the size of the piece of biscuit had been reduced to almost nothing. During the whole teaching period the students were very responsive and alert. This technique helped the teacher to achieve the objective of the lesson i.e., when population increases, food becomes scarce, and habitable and irrigable land becomes less. This type of contrived experiences could well be used in many teaching-learning situations in any part of the world.

Another interesting feature witnessed was the use of equipment and materials by the teachers as and when required. This approach kept the students attentive and busy. Many schools in other developing countries may not be able to provide all the equipment and materials required for a particular lesson, but interested teachers could substitute most of the equipment by improvised apparatus and equipment. It was seen that the use of improvised materials prepared with the help of students goes a long way to make a lesson successful, a practice which needs to be encouraged in all the countries.

In-service training of science teachers

The in-service training programmes for teachers have been given top priority in India and Philippines. This has become imparative due to the new curricula used in the respective school systems both at the elementary and secondary levels. Though a concerted effort is being made to reach as many teachers as possible, especially in the rural and remote areas, through these in-service programmes, due to reasons beyond the control of the institutions responsible for the implementation of the programmes, it has not been possible to achieve this objective. So it would be necessary to work out new approaches to eliminate or minimize the existing constraints for these programmes. An apparent weakness of this programme is the absence of a process or method of evaluating the programme with a view to omitting the weak points and strengthening the others. Hence it would be necessary to build into the in-service programme techniques for this purpose, so that it would be possible to assess the contribution made by this programme, not only to upgrade the professional competnecies of the teachers, but also the improvement of the quality of classroom teaching.

Hoshangabad Project

This is a challenging task undertaken by a group of educators. Though the group is working under several constraints, there is a measurable success in this project, which attempts to make science education accessible and meaningful to the children of the remote and rural schools in Madhya Pradesh. As teachers involved in this project were mostly non-science based, it would be necessary to train them in techniques of classroom management for experiments. It was noted that in many instances, for lack of this type of training, teachers wasted time in distributing equipment and materials.

THAILAND

The experiences gained during the Mobile Field Operational Seminar can be used for development of education in many ways. In the area of science curriculum development, there are many ideas gathered which can be used for the improvement of our on-going programmes.

The establishment of regional centres and their satellites. The multiplying effect of the programme is a unique one, and it is a valuable system to decentralize educational facilities to regional areas on the one hand, and utilize local expertise on the other. A similar approach was recognized and adopted by the IPST. Teachers' colleges all over the country are and will be appointed as regional centres for this purpose, and can profit from the Philippine experience.

In carrying out this programme from ideas to functional organization, problems still exist, since science service centres require physical facilities, qualified personnel, and an effective administration. In this respect, activities conducted at the Science Centres in Delhi can be taken into consideration.

The in-service training programmes to upgrade biology teachers in particular competencies undertaken by the UPSEC is one of the most interesting programme. Essential teaching competencies have been identified and divided into parts. Specific training experiences are designed for teachers to acquire skills needed for a particular competency. The period of training is sufficient. This seems to be a more effective programme than the traditional ones in which all teaching competencies as well as other components are attempted to be covered in a very short time.

According to the in-service programme in teacher training institutions, a few questions that should be asked are: (a) how a pre-service programme should be arranged to obtain qualified teachers; and (b) what are the necessary supplementary competencies for effective teaching related to teacher's real-life needs. The answers to these questions are now being attempted through a research and development project named "THAI-STEP". However, the SUPW programme concerning skills needed in laboratory equipment production and repairs conducted by the Regional College of Education at Bhopal is one of the useful programmes to provide an answer to the second question.

Experiences gained from the observation at Balara Elementary School provided an excellent sample of the transformation of theories in curriculum development into actual classroom practice. It is realized that research and development for more appropriate materials must be carried out as a continuous process. Otherwise the phenomena in actual classroom situations might be another story away from the set objectives.

The Word in Science Project (WISP) is very interesting. It is an example of essential studies to be carried out for effective implementation of a newly developed science curriculum programme.

The environmental study project for elementary school children in NCERT is a new trend in curriculum development that tries to give another answer to the question "What should be learned?" Although it is one of the most interesting projects, the IPST had the benefit of a detailed study of the same some time back through an attachment facility, and the experience gained has already been utilized for developing at the IPST a somewhat similar approach.

Supplementary materials such as books, films, slides, are of real use in the development of students' understanding of science. The IPST is also interested in this programme and some of these materials, most of which are books and slides, are provided for schools all over the country. However, more work still needs to be carried out.

Linking science education to rural environment

According to the IPST's own major activities, i.e., the development of science curriculum materials, many aspects need to be considered for improving the existing materials and to relate them to real-life situations in Thailand. Improvements can be done not only in terms of illustrations on activities designed, but also the utilization of surroundings to develop certain scientific concepts, and should be done as often as possible in any topic, not only in certain particular ones which seem obviously to be related to real-life situations by their own content, e.g., the topics on nutrition or conservation of natural resources.

Annex I

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APEID PUBLICATIONS RELATED TO SCIENCE EDUCATION

Unesco, P.O. Box 1425, Bangkok G.P.O., Bangkok, Thailand

1. *Science in basic functional education: philosophy, approaches, methods and materials; report. 1975*

2. *Science in basic functional education: links with real-life situations; report. 1975* *

3. *Integrated science in the junior secondary school in Sri Lanka; study. 1976*

4. *Science in basic functional education; report (of a Module-Writing Workshop). 1977* *

5. *The Institute for the Promotion of Teaching Science and Technology of Thailand; study. 1977*

6. *Selection, maintenance and repair of school science equipment; report. 1978*

7. *Physics curriculum development in Asia; report. 1978*

8. *Making and using low-cost educational materials; report. 1979*

9. *Universalizing education: strategies for development and use of instructional materials; report. 1979. (includes six projects on science education, and guidelines for the design, development and use of science instructional materials).*

10. *Designing instructional materials for general education and teacher training: a portfolio of experiences in Asia and Oceania. 1980 (includes a section on science education).*

11. *Self-learning modules for teachers (two of a series already published: (i) Soil salinity and your crops; (ii) Good-bye waste).*

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* Out of stock

The *Asian Programme of Educational Innovation for Development (APEID)*, initiated on the recommendation of the Third Regional Conference of Ministers of Education and Those Responsible for Economic Planning in Asia (May–June 1971, Singapore) and the authorization of the General Conference of Unesco at its seventeenth session (Paris, 1972), aims at stimulating and encouraging educational innovations linked to the problems of national development in the Asian region.

All projects and activities within the framework of APEID are designed, developed and implemented co-operatively by the participating Member States through their national centres which have been associated by them for this purpose with APEID.

The 18 Member States in Asia and Oceania participating in APEID are: Afghanistan, Australia, Bangladesh, India, Indonesia, Islamic Republic of Iran, Japan, Lao People's Democratic Republic, Malaysia, Nepal, Pakistan, Papua New Guinea, Philippines, Republic of Korea, Singapore, Socialist Republic of Viet Nam, Sri Lanka and Thailand.

The Asian Centre of Educational Innovation for Development (ACEID) has been established at the Unesco Regional Office for Education in Asia and Oceania in Bangkok to co-ordinate the activities under APEID and to assist the associated national institutions in carrying them out.

The aims of APEID are:

- to stimulate efforts of the Member States to improve the quality of life of the people through creating and strengthening national capabilities for the development and implementation of innovations in education, both formal and non-formal;
- to encourage the Member States to make all groups (students, teachers, parents, village and community leaders, administrative personnel and policy makers) aware of the need for relevant changes in education (both formal and non-formal) as an essential pre-requisite for the improvement of the quality of life of the people;
- to promote understanding and appreciation of the differences in educational practices and approaches of the Member States, and thereby contribute to international understanding and the creation of a new international economic order.